

AD-A282 436



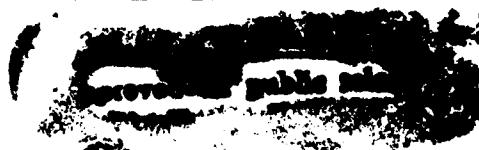
RAND

*Theater Analysis and Modeling
in an Era of Uncertainty: The
Present and Future of Warfare*

*Bruce W. Bennett, Sam Gardiner,
Daniel B. Fox, Nicholas K. J. Witney*

DTIC
ELECTE
JUL 26 1994
S G D

National Defense Research Institute



94-22958



11896

DTIC QUALITY INSPECTED 1

94 7 21 040

The research described in this report was sponsored by the Director of Net Assessment, Office of the Secretary of Defense (OSD), and conducted in Rand's OSD-supported federally funded research and development center under Contract No. MDA903-90-C-0004.

Library of Congress Cataloging in Publication Data

Theater analysis and modeling in an era of uncertainty : the present and future of warfare / Bruce W. Bennett ... [et al.].

p. cm.

"Prepared for the Director of Net Assessment, Secretary of Defense."

Includes bibliographical references.

"MR-380-NA."

ISBN 0-8330-1511-7

1. Military planning. 2. War games. 3. World politics—
1989— I. Bennett, Bruce W., 1952— II. United States.
Dept. of Defense. Director of Net Assessment.

U150.T49 1994

355.478—dc20

94-4161

CIP

RAND is a nonprofit institution that seeks to improve public policy through research and analysis. RAND's publications do not necessarily reflect the opinions or policies of its research sponsors.

Published 1994 by RAND

1700 Main Street, P.O. Box 2138, Santa Monica, CA 90407-2138

To obtain information about RAND studies or to order documents,
call Distribution Services, (310) 451-7002

RAND

*Theater Analysis and Modeling
in an Era of Uncertainty: The
Present and Future of Warfare*

*Bruce W. Bennett, Sam Gardiner,
Daniel B. Fox, Nicholas K. J. Witney*

*Prepared for the
Director of Net Assessment,
Office of the Secretary of Defense*

National Defense Research Institute

| | |
|---------------------|--|
| Accession For | |
| NTIS CRA&I | <input checked="checked" type="checkbox"/> |
| DTIC TAB | <input type="checkbox"/> |
| Unannounced | <input type="checkbox"/> |
| Justification | |
| By | |
| Distribution / | |
| Availability Codes | |
| Dist | Avail and / or Special |
| A-1 | |

Preface

This monograph report combines the products of two efforts to examine the future of warfare. In one effort, we have used a form of manual gaming to analyze how warfare is likely to evolve given the changed circumstances in the world around us.¹ This effort has led to a number of conclusions about the possible character of the future of warfare. The second effort addressed some of the patterns of the future of warfare and asked how military analysis and modeling would need to adjust to appropriately reflect these changes.

This work was pursued as part of the development of the RAND Strategy Assessment System (RSAS), which is a global analysis and gaming system for major regional contingencies. While these conclusions are of general interest to analysts and modelers in the defense community, they will be used specifically to organize and prioritize future RSAS development efforts.

Development of the RSAS is sponsored by the Director of Net Assessment in the Office of the Secretary of Defense and is performed within the International Security and Defense Strategy Program of RAND's National Defense Research Institute, a federally funded research and development center sponsored by the Office of the Secretary of Defense and the Joint Staff.

Comments and inquiries are welcome and should be addressed to the principal author or to Dr. Charles Kelley, Director of the International Security and Defense Strategy Program.

¹These games are described in some detail in Bruce W. Bennett, Margaret Cecchine, Daniel B. Fox, and Samuel Gardiner, *Technology and Innovations in Future Warfare: Wargaming the Persian Gulf Case*, N-3603-NA/OSD/AF/A, RAND, 1993.

Contents

| | |
|--|--------|
| Preface | iii |
| Figures | vii |
| Tables | ix |
| Summary | xi |
| Acknowledgments | xxxiii |
| Glossary | xxxv |
| 1. INTRODUCTION | 1 |
| Purposes and Context | 1 |
| Setting the Context | 1 |
| 2. HOW WARFARE HAS DIVERGED FROM MILITARY ANALYSIS AND MODELING | 4 |
| Discontinuities in Warfare | 4 |
| Qualitative Factors, Uncertainties, and Combined Arms | 6 |
| Addressing These Problems | 7 |
| 3. GAMING OBSERVATIONS ON THE FUTURE OF WARFARE | 8 |
| Setting the Conditions and Objectives for War | 9 |
| Opposition Preparation for Future Conflicts | 13 |
| Setting the Political Context: Limiting U.S. Power | 13 |
| Setting the Political Context: Developing Coalitions | 14 |
| Setting the Political/Military Context: Limiting U.S. Response Time | 17 |
| Operational Concepts and Force Postures | 18 |
| Air Forces Are the Future U.S. Center of Gravity | 19 |
| Technologies Can Also Work Against the United States | 19 |
| Weapons of Mass Destruction | 21 |
| C ³ I Requirements and Implications | 23 |
| Conclusions | 24 |
| 4. STRUCTURING OUR THINKING ON THE FUTURE OF WAR | 26 |
| What Kinds of Contingencies Have Been Considered? | 26 |
| Warfare Will Be Characterized by Uncertainty and Variability | 27 |
| New Patterns of Warfare | 30 |
| Opponent Manipulation of the Strategic Context | 33 |
| Manipulating the Strategic Environment | 35 |
| Management of the Campaign: The Operational Environment | 36 |
| Asymmetrical Battles Will Characterize War | 38 |
| The High-Tech, Regular Combat Battlefield | 38 |
| A Reactive Approach | 40 |
| Countering U.S. Strengths | 41 |
| Example: Countering U.S. Air Forces | 42 |
| The Low-Tech, Irregular Combat Battlefield | 44 |

| | |
|---|----|
| The Combined Battlefields of the Future | 46 |
| Nuclear, Biological, and Chemical Weapons | 47 |
| 5. HOW ANALYSIS AND MODELING MUST RESPOND TO THE FUTURE OF WAR | 50 |
| Requirements for a New Analytic Approach | 50 |
| Handling the Differences in Warfare Environment | 51 |
| Following Strategic and Operational Events | 53 |
| Defining the Prospective Events | 55 |
| How Might the Events Be Caused or Prevented? | 55 |
| What Are the Likely Implications of These Events? | 56 |
| The Counter Capability Framework | 56 |
| Simplified Models | 60 |
| The Implications of "Regional" Weapons of Mass Destruction | 62 |
| Addressing the Uncertainties | 63 |
| Modeling Issues | 64 |
| 6. CONCLUSIONS | 66 |
| Appendix: TAKING THE PROPOSED ANALYTIC APPROACH A STEP FURTHER | 69 |
| References | 83 |

Figures

| | |
|--|------|
| S.1. A Threat Menu | xxi |
| S.2. Following Strategic/Operational Events: A Simplified Example .. | xxiv |
| 1.1. Setting the Context | 2 |
| 4.1. Classifying Future Contingencies | 28 |
| 4.2. U.S. Assumed Pattern of Warfare | 31 |
| 4.3. A Threat Menu | 43 |
| 5.1. Key Characteristics of Regional Conflicts | 52 |
| 5.2. Following Strategic/Operational Events: A Simplified Example .. | 54 |
| 5.3. Considering Air Base Attack in More Detail | 60 |
| A.1. Following Operational Events: A Simplified Example | 69 |

Tables

| | |
|---|-------|
| S.1. Differences in Warfare Environment (an example) | xvi |
| S.2. Some Possible Opposition Reactions to U.S. Air Superiority | xxvii |
| 4.1. Differences in Warfare Environment (an example) | 29 |
| 5.1. Characterizing Counters to Military Capabilities | 58 |
| 5.2. Possible Opposition Reactions to U.S. Air Superiority | 59 |
| A.1. South Korean Defensive Lines | 71 |
| A.2. Comparing Possible North Korean Forward Attack Operations . . | 72 |
| A.3. FAE/Chemical Artillery Rounds Required for "Artillery Terror" Concept | 77 |
| A.4. CFC Responses to North Korean Assault Concepts | 79 |

Summary

This monograph report describes work done as part of the development of the RAND Strategy Assessment System (RSAS), an initiative of the Director of Net Assessment in the Office of the Secretary of Defense to improve the procedures used for analysis and modeling of major regional contingencies and higher-level conflicts. Because many of the key aspects of warfare have changed significantly over the last few years, and likely will change even more significantly in the next decade, a major component of recent RSAS development has been research into the future of warfare. This report summarizes a part of that work, describing some of our vision of the future, and what we believe that vision implies about requirements for military analysis and modeling of major regional contingencies. The work included here has involved war gaming and analysis, has spanned the spectrum of major force operations, and has considered both the present and future of warfare.

Present Military Analysis and Modeling

The Cold War is over, but military analysis and modeling remain heavily tied to the assumptions of the Cold War era. Many of those assumptions were oversimplified because an adequate military science was lacking as the background for analysis and modeling. For example, most military analysis and modeling today fail to recognize many of the discontinuities between tactical and operational level phenomena and treats battles and campaigns as continuous (for example, ignoring breakthroughs). These efforts do not adequately handle the qualitative (soft) factors of warfare (such as training or force cohesion), the uncertainties and variations in conflict outcomes, and important phenomena such as combined arms effects. While some efforts have addressed many of these issues (including a number of RSAS experimental methodologies), there is no agreed-on approach to these issues or even a firm understanding within the community on the issues that need to be addressed. While some may argue that a lack of consensus in the community on such issues could be healthy (by providing a range of approaches and alternative views), it is a major cause for studies reaching contradictory results, which in turn seriously complicates the ability of policymakers to derive meaningful insights from analysis.

Observations from Future of Warfare Games

If military analysis and modeling are on shaky grounds today, their ability to deal with future warfare is even more questionable. There is no agreed-on perception of how warfare is evolving; indeed, many appear to believe that warfare is not evolving greatly, other than the United States enhancing its existing military dominance (with new technologies such as sensor-fuzed weapons or antiballistic missiles). To investigate the future of warfare, we conducted a series of war games in which we had players pay particular attention to what regional opponents (Red forces) might be able to do in preparing today for a future conflict that might involve the United States and then had them consider how friendly (Blue) forces might respond. These games provided insights such as:

- If the United States can effectively project its forces into a theater, it likely can achieve some degree of military dominance in many future conditions. If opponents cannot win in the long run because of this military dominance, they must attempt to keep the war short and attack the U.S. will to intervene in such conflicts. Opponents may also oppose U.S. deployments to gain time to achieve their objectives.
- It is difficult to determine what conditions would undermine U.S. will. However, opponents are likely to be more effective in doing so if they: (1) seek for limited objectives achievable before the United States can intervene (within a few weeks), (2) threaten serious loss of U.S. lives if the country becomes involved, and (3) prevent the United States from being able to form a clear sense of national interest. Red players were less certain of the effects of actually killing U.S. personnel (would the U.S. response parallel Pearl Harbor or Beirut?) and especially of extending their attacks back into the United States. (We suspect this latter concern is more a reflection of the U.S. background of our players, and does not reflect the culture of likely opponents.)
- Some future opponents may start a regional conflict as a last, desperate act, attempting to maintain control of their regime. It will be important to properly characterize such cases because desperate opponents will likely be prepared to use force and war more extensively (including the potential use of nuclear weapons) and will be much less susceptible to efforts to deter their incremental actions during the war.
- Many Red players believed that they could influence the changing U.S. force posture over time. They could best achieve their objectives in a future conflict if they appeared relatively passive before the conflict and by doing so

contributed to convincing the United States that it could reduce its conventional forces because of the lack of a threat in the world.

- The United States will be fairly dependent on international coalitions in future conflicts, and especially on support of at least some regional powers (for basing and other issues). Red players believed that they could disrupt such coalitions, both by supporting long-term frictions between the United States and its prospective allies and by positioning themselves to appropriately coerce prospective allies at conflict time.
- Most Red players believed that they gained far more advantage against the United States by executing a short warning attack than they lost by minimizing their preparations. They also believed that the U.S. requirement to form both domestic and international coalitions could significantly slow U.S. responses. This advantage then could be exploited by high mobility assault and seizure efforts to achieve the limited Red objectives.
- Red operations would be facilitated if they acquired a number of technologies that would counter the strengths of the United States and its likely allies, to include light anti-armor weapons (such as the FOG-M or sensor-fuzed weapons mounted on cruise missiles), weapons for standoff attack on airfields (including ballistic and/or cruise missiles and either improved conventional munitions or weapons of mass destruction), and weapons that would deny the United States air control (especially advanced surface-to-air missiles such as the SA-10) and sea control (such as advanced mines and anti-shipping missiles). Many of these technologies have already been developed by the United States and other foreign powers and might be available either on the arms market or through clandestine operations against the United States or others in peacetime.
- Air force operations are the U.S. center of gravity. Red players felt confident of achieving their objectives if they could neutralize U.S. air forces through a combination of attacks on air bases, air and sea denial efforts, and protection of valued targets. They were far from certain that they could accomplish this task.
- U.S. nuclear forces were perceived as giving the United States scant advantage in future regional conflicts. But Red players felt that nuclear weapons might give them substantial leverage, both in ensuring basic regime survival and in intimidation and warfighting. In particular, they believed that their having nuclear weapons might seriously discourage U.S. involvement in a regional conflict. Thus, Red operations could launch an effective (albeit high-risk) early strike against U.S. forces if the United States chose to be involved. Blue players generally responded to Red nuclear

attacks using conventional means. They believed that there was no operational need for nuclear weapons in defeating the opponent and feared a negative domestic and international reaction to U.S. nuclear weapon use.

- Blue players felt that the command, control, communications, and intelligence systems of the future needed to be very robust and adaptive, supporting the requirements of advanced weapon systems and providing good control and situational awareness for the commander.

Thus, despite its military power, the United States may face severe challenges in future major regional contingencies.

Beyond War Games: Structuring Our Thinking on the Future of War

We have analyzed the observations from the war games in some detail and extended them into an initial structure for thinking about the future of warfare and its implications for analysis and modeling. Our proposed structure focuses on four issues: (1) Warfare will be dominated by uncertainty and variability, (2) adversaries will seek new patterns of warfare to effectively oppose the United States, (3) asymmetrical battles will characterize war, and (4) weapons of mass destruction will cast a shadow over almost all future contingencies.

In developing this structure, we recognize that the experience of Operation Desert Storm is compelling and dominates the thinking of many about the future of war. We can be fairly certain, however, that future contingencies will not be just a rerun of the Persian Gulf War—in part because of the diversity of conflicts in which we could become involved and also the reactions of our prospective adversaries to the Persian Gulf War.

“As in any game from football to chess, each contestant is possessed of an independent will and can only be controlled by the other to a very limited extent. With each side seeking to achieve his objectives while preventing the other from doing the same, war consists in large part of an interplay of double-crosses. The underlying logic of war is, therefore, not linear but paradoxical. The same action will not always lead to the same result. The opposite, indeed, is closer to the truth. Given an opponent capable of learning, a very real danger exists that an action will not succeed twice because it has succeeded once.”¹

¹Martin van Creveld, *Technology and War: From 2000 B.C. to the Present*, The Free Press, New York, 1989, p. 319. The passages quoted and related insights were originally published in Sam Gardiner, “It Isn’t Clear Ahead, But I Think I Can See the Edges of the Road: The Character of Future Warfare,” *RSAS Newsletter*, RAND, November 1992.

Sun Tzu also recognized the folly of trying to repeat previous successes when he stated in *The Art of War*:

"Do not repeat tactics that have gained you one victory, but let your methods be regulated by the infinite variety of circumstances."

Warfare Will Be Dominated by Uncertainty and Variability

Future warfare is very uncertain. We do not know, for example, who the U.S. opponents will be (from a single country to some opposition coalition), what their objectives will be, how they will attempt to win, what military technologies they will possess, what kind of force structure they will have, and how they will employ their forces. We also cannot be certain of the U.S. response to such threats. By comparison, the historical Soviet threat was relatively certain in many dimensions and faced much more moderate uncertainties, primarily in areas such as actual weapon capabilities and how troops would really perform. While much of historical defense planning and analysis focused on "expected" conditions, the recent course of contingencies suggests that ignoring what often will be vast uncertainties is a serious peril.

Many of these factors can be expected to vary enormously from possible theater to possible theater, along with other variables such as weather, terrain, and infrastructure; the degree of possible allied involvement on either side of the conflict; and the coherence and motivation of the adversary's forces. These factors define the warfare environment that we would experience in a given contingency. To better clarify the kinds of differences that might be expected, Table S.1 contrasts conditions in the historical Central European environment—the basis for most models—and the Korean theater.

Historically, it was argued that Soviet doctrine and weapons pervaded almost any adversary the United States might face, and, therefore, U.S. defense thinking could focus on Soviet style and capabilities as those of the adversary. Such an approach no longer appears appropriate; instead, defense planners and analysts must be prepared to explicitly address differences in warfare environment among contingencies. We believe that the proper approach is to create a new class of "strategic and operational variables" that would more systematically define how various contingencies might differ from each other and also help identify the uncertainties faced in any given theater. These variables would likely be similar to the "Major Issue" column in Table S.1,² though clearly many

²A more thorough discussion of strategic and operational variables is found in Bruce W. Bennett, "Flexible Combat Modeling," *Simulation & Gaming*, June 1993, pp. 213-219 (also available as a RAND reprint, RP-220).

Table S.1
Differences in Warfare Environment (an example)

| Major Issue (Example) | Historical Central Europe | Korean Theater |
|--|--|---|
| (U.S.) Objectives | Survival of current world system | Aid regional ally |
| Strategy (Adversary) | Defeat U.S./NATO forces in the field (selectively defeat weak partners) | Deter U.S./Japan involvement by creating "strategic events" |
| Operations (Offensive ground concept) | Penetrate and envelop defending forces to destroy them; secure terrain objectives | Suppress and rapidly penetrate defending units to break their attack cohesion and secure terrain objective |
| (Offensive air attack concept) | Use offensive counterair to suppress NATO air forces; establish local air control where possible | Suppress CFC air forces with special operations forces and missiles; threaten Seoul and support ground forces when possible; use ambush tactics defensively |
| (Chemical use) | Low chance, high preparations | High chance, low preparations |
| Resources (Assault forces) | Heavy forces with artillery support | Infantry with artillery and special operations forces support |
| Performance (Adversary training) | Not as good as NATO in air or ground training, but close? | Highly inferior in air training, though tactics appropriate; superior to South Korea in ground training? |
| Allied Cooperation (Defensive alliance) | Large group of allies who clearly perceive a mutual threat | ROK firm, United States likely firm, other regional actors may delay in participation |
| Other factors (Ability of terrain to support armor) | Good—extensive road network and many good off-road options | Poor—mountains channel terrain, few roads, rice paddies deny most off-road options except in winter |

other issues would need to be identified. Such variables should be valuable in defense planning, training, and analysis; at the very least, they would provide a framework for thinking about the implications of alternative contingencies.

Adversaries Will Seek New Patterns of Warfare to Effectively Oppose the United States

The conclusion that the next major regional contingency (MRC) is unlikely to resemble the Persian Gulf War is reinforced by the fact that, for whoever next

decides to take on the United States, directly avoiding a repeat of the Persian Gulf War scenario is likely to be a prime objective. The Persian Gulf War was the paradigm of what U.S. forces, as currently equipped, trained, and structured, do best.

It follows that the next U.S. adversary will do whatever possible to avoid a conflict of the Persian Gulf type. He will no more seek to confront U.S. power on U.S. terms than David would have gone out against Goliath with a sword and shield. His prime aim will be to ensure that U.S. conventional forces cannot be brought decisively to bear. He will realize that the pattern for the successful application of U.S. force requires time, cooperative allies in the region, and an enemy willing to present and identify himself. The intelligent adversary will seek to deny all these to the U.S. and should be able to do so because, in most cases, he will have the initiative. He will attempt to counter U.S. capabilities at the operational level, but he will realize that *his most effective responses will be made at the strategic level*, by deterring U.S. will to enter the conflict, by inducing the United States to discontinue intervention if it occurs, and by wearing out U.S. resolve and interest. The adversary would seek for "strategic events," which would cause the United States to change its strategy.

The adversary will likely seek to undermine U.S. will and otherwise mold future contingencies in three general ways:

Opponent Manipulation of the Strategic Context. Future regional aggressors will likely take pains with the political stage-management. Events must be handled so as to provide the United States with the best possible excuses and reasons not to intervene or to terminate an intervention once begun. Some of the political strategies that, singly or in combination, might contribute to affecting the United States will include:

- The situation should be presented as one in which U.S. intervention is demanded neither by U.S. national interest (e.g., the security of nationals or access to oil) nor by considerations of principle (because the government attacked is totalitarian, oppressive, and/or in a state of anarchy);
- the aggressor will pursue a "short war" to obtain limited objectives, trading less-than-perfect preparedness for surprise; and
- aggression will likely be timed to take place when the United States is distracted by some significant crisis elsewhere.

The interesting question is, "What does it take to deter U.S. intervention?"

Managing the Campaign: The Strategic Environment. In future conflicts, the United States will want a quick, decisive campaign with relatively few casualties. The adversary must demonstrate that this U.S. game plan will not be achievable. Some skills will be required in the modulation of the level of violence. A strategic event involving some spectacularly heavy loss of U.S. forces at the outset of the conflict may lead to a U.S. withdrawal like that following the car-bomb attack on the U.S. Marines in Beirut several years ago or a firm U.S. commitment like that following the Japanese attack on Pearl Harbor. Creating the proper kind of strategic event suggests that the smart adversary may follow a progressive approach, along the following lines: (1) demonstrate that conflict participants are suffering relatively high casualties from the beginning (on both sides), with full access given to the U.S. and international media; (2) inflict casualties on the United States initially by "indirect" means, avoiding an incontrovertible "signature," and, therefore, not providing a clear justification, or target, for retaliation; (3) create a strategic event (e.g., devastating terrorism or the use of weapons of mass destruction) with sufficient military or psychological impact to stop the intervention in its tracks and cause the United States (and its partners) to reassess the wisdom of the course on which they are embarked.

Management of the Campaign: The Operational Environment. At the operational level, the opponent might attempt to create a battlefield environment more like Vietnam than the Persian Gulf by maximizing U.S. casualties, using infantry engagements (a nonlinear battlefield and close contact with U.S. forces); fighting in urban terrain, where it may be difficult for the United States to employ its dominant weaponry; and resorting to classical guerrilla tactics as required. He might contaminate air bases, ports, and other facilities to force the United States to abandon them for fear of excessive casualties. He might proliferate air defense artillery and shoulder-fired surface-to-air missiles (SAMs) to deny aircraft operations below 10,000 to 15,000 feet. He might make some operations such as amphibious landings appear to be too risky by posing the threat of a nuclear response.

From the opposition perspective, clearly, it would be ideal if they could create operational events that also could become strategic events. Thus, if North Korea could induce the United States to abandon its air bases in South Korea, and by so doing cause a crisis of U.S. will for intervention in a Korean War, the operational development will have well served overall North Korean objectives. The opposition must still recognize, though, that the outcome of such a strategic event could be a renewed and expanded U.S. intervention (especially if many Americans are killed by chemical weapons or a nuclear attack).

Asymmetrical Battles Will Characterize War

Recent military discussions have described several alternative future battlefields. Russian writings have focused on a high-tech, symmetrical development along the lines of what the U.S. achieved in Operation Desert Storm and what it is seeking with further developments of military technologies. Few if any future U.S. opponents, however, will likely be able to respond symmetrically to the United States, and we, therefore, anticipate that future battlefields will develop asymmetrically.³ The extremes in asymmetry may occur if a high-tech U.S. force is countered by a guerrilla force, practicing irregular warfare. These alternatives have substantially different implications from each other and require an analytic approach that allows all the alternatives to be considered.

Traditional military analysis has tended to be symmetrical. For example, analysts have examined tanks versus tanks or fighters versus fighters, either in static or engagement analysis. However, the United States military force structure is increasingly diverging from that of prospective adversaries, in part because many of the U.S. military strengths are based on U.S. military culture and training (e.g., maneuver warfare and air tactics and operations) that many regional powers cannot hope to duplicate. Instead, regional powers appear to be pursuing simpler force structures but ones that could present the United States with problems in future contingencies. For example, ballistic and cruise missiles require little of the elaborate coordination of forces that tends to characterize U.S. military operations; yet, they could be a real threat to U.S. forces. We refer to such threats as being asymmetrical because prospective opponents will attack our strengths with other kinds of capabilities.

To better understand the threats we might face, we need to characterize how regional powers will likely seek to counter U.S. strengths. Imperfect U.S. intelligence forces us to address questions such as:

- What counters are possible?
- How effective might these counters be? Do they apply in only limited cases?
- Which of the more effective counters might be within the reach of specific opponents?
- How might the United States respond to and/or overcome these counters?

³The importance of the asymmetrical battle first came to our attention in the work done by LtGen. Phil Shutler, USMC (Ret). General Shutler applied the framework of asymmetrical battle to describe the success of U.S. operations in the Pacific during World War II.

We propose using a "threat menu," as illustrated in Figure S.1, to address these issues. Here "threat menu" refers to the range of battle and engagement approaches open to an opponent seeking to counter a specific U.S. capability—in the current example, U.S. air power. An adversary might select one or, more likely, many approaches from this range. For example, an adversary might target U.S. airfields while interdicting the regional fuel supply and fielding a range of surface-to-air missiles with which to defend its forces and infrastructure. The threat menu allows us to focus on the kinds of threats that might be posed. Then we can decide those that are significant and serious enough to be taken into account in formulating potential threat environments (to contribute to a proper understanding of the warfare environment discussed above) and in developing intelligence collection requirements for a given theater.

To the extent that threats are truly asymmetrical, a different kind of military competition will result. Rather than the historical pattern of competition in largely symmetrical areas (e.g., tanks versus tanks or fighters versus fighters), analysts should expect opponents to pursue many different technologies in a combined-arms approach to deal with U.S. strengths (and not just looking for a single "silver bullet" to defeat U.S. forces). This strategy complicates analysis because it largely invalidates simple symmetrical capability comparisons (such as the traditional tank versus tank measures) and requires a battle or campaign orientation to make meaningful comparisons.

Weapons of Mass Destruction Cast a Shadow Over Almost All Future Contingencies

Nowhere will the asymmetries be more pronounced than in the respective readiness of the United States and the potential regional adversaries to introduce the shadow of weapons of mass destruction, and even their use, into a crisis.

Third party interest in nuclear weapons may be driven by ambitions for regional domination; our gaming suggests that it may also be driven by a perception of nuclear weapons as the ultimate means for ensuring regime survival. Proliferants will be very conscious of the effect of their acquisition on the regional balance of power (as demonstrated, for example, by the Japanese reaction to the prospect of a North Korean nuclear capability). Should conflict occur (whether with another regional power or with the United States), they will be aware not merely of their arsenal's potential to intimidate or deter but also how the weapons' use could decisively affect the course of the conflict (that is to say, the potential of nuclear weapons for creating strategic events).

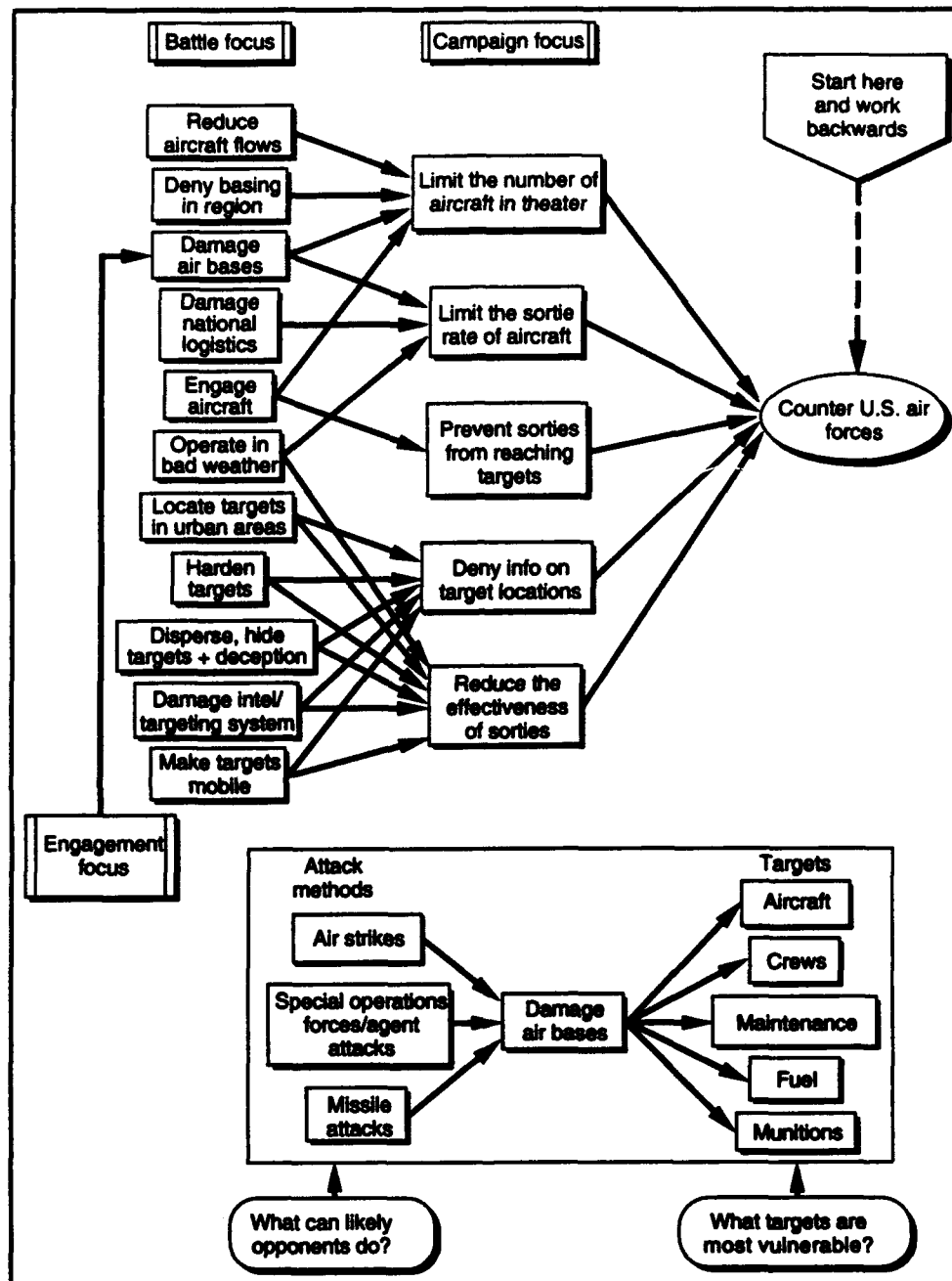


Figure S.1—A Threat Menu

The threat of nuclear, biological, and chemical (NBC) weapons might affect contingencies in several ways. Adversary possession of an NBC arsenal may be a strong disincentive for the United States to intervene in the first place. Potential coalition partners, especially those geographically closest to the adversary, may be more difficult to enlist, fearing nuclear strikes from the aggressor. The

possibility of tactical use may seriously inhibit U.S. deployment and operational planning. The United States may have to reconsider its doctrine of strategic attack, since it threatens the existence of the aggressor's regime, and the aggressor will likely look to nuclear weapons to assure that survival.⁴ Even after a successful conventional campaign, coalition war aims may have to be circumscribed to avoid threatening the adversary's ultimate survival and thus potentially triggering a Samson response.

The actual use of NBC weapons would be a high-risk strategy for the adversary, but it, therefore, should not be regarded as excluded. As a major "strategic event," it might disrupt the whole political momentum of the U.S. response. It could certainly be expected to induce a pause on the battlefield, while Washington and other coalition capitals digested the implications. It might sow discord among coalition partners, as arguments ensued as to the appropriate response, and an adversary might calculate that it would in effect be a "no-added-cost" option. Given an increasingly advertised U.S. tendency to view nuclear weapons, as much as chemical and biological weapons, as lacking both utility and legitimacy; the adversary might reasonably calculate that the U.S. response to his own NBC use would merely be continued prosecution of the war against him by conventional means.

How Analysis and Modeling Must Respond to the Future of War

The current era of uncertainty suggests that the traditional approach to military analysis, dominated by a linear scenario with at best modest sensitivity analysis, is no longer appropriate. In the traditional approach, no matter how much attention has been paid to considering variations around the baseline scenario, almost all analyses still gravitate to the "expected value" outcome of a single course of events that has low probability, given the uncertainties. Moreover, there does not appear to be a marginal improvement on the traditional approach that resolves these difficulties; instead, a new approach is required.

Requirements for a New Analytic Approach

The Cold War analytic approaches were simplifications that may have been appropriate for the time, but they are no longer appropriate for military analysis.

⁴Said differently, attacks against the aggressor's leadership pressed to the point where that leadership feels its survival is threatened may trigger a nuclear response that is intended to change the U.S. strategy and remove the threat to the aggressor's regime.

The six areas that we feel must change (each is discussed in more detail herein) are summarized below:

1. Analysis and modeling must **reflect the significant differences in the warfare environment that will exist between theaters**. Soviet doctrine and equipment, among other things, can no longer be the standard for analysis.
2. Analysis needs to **focus on strategic and operational events, variations, and uncertainties**. Analysis needs to draw out the *variety* of possible outcomes, at both strategic and operational levels, and identify the factors contributing to the key events that will determine the course the conflict actually takes and its outcome.
3. To better understand the range of combat operations that could occur, we should **adopt a "counter-capabilities" approach to defining military threats**. This approach will develop threat menus that allow analysts to consider the range of possible threats that help define warfare environments.
4. The community needs to **adopt a new approach of developing simple but more comprehensive models**, which are sufficiently transparent so that trade-offs between inputs and key assumptions can be adjusted to reflect the impact of the variations discussed above.
5. Analysts need to **address issues associated with the regional shadow of weapons of mass destruction**.
6. Analysts need to **develop new procedures for presenting the uncertainties of their analyses to decisionmakers** and making these uncertainties more comprehensible.

While the first impression that these points create is that analysis needs to be more complex, they really mean that analysis must emphasize the range of military phenomena that could affect outcomes; in order to do so, the modeling base likely needs to be simpler but broader.

Handling the Differences in Warfare Environment

A new class of strategic and operational variables needs to define differences in warfare environments among theaters. These variables would not be inputs to a combat model but rather characterizations of warfare environments that would give the analyst a basis for capturing the differences between environments. They would include issues such as described in Table S.1, with "military operations and doctrine" including factors such as the concept of assaults, the concept of breakthrough exploitation, the concept of air defense, the concept for countering surface naval forces, and the concept for amphibious forces. Different

assumptions in these areas would require different analytic and modeling procedures for measuring the outcome of a given operation.

Following Strategic and Operational Events

We believe that future warfare will be dominated by strategic and operational events, both on the battlefield and in analysis. At the strategic level, difficulties experienced in the theater may fundamentally affect U.S. will and cause the United States to change strategy; analysis must capture the implications of the alternative strategies pursued thereafter. At the operational level, a breakthrough on the ground or the establishment of air superiority in the air changes the entire character of analysis from that point on in the contingency.

Figure S.2 provides a simple example of the sort of sequences of strategic and operational events that analysis ought to consider in the context of a full North Korean assault on South Korea. At the strategic level, the North Koreans would likely pursue a variety of attacks designed to convince the United States that this

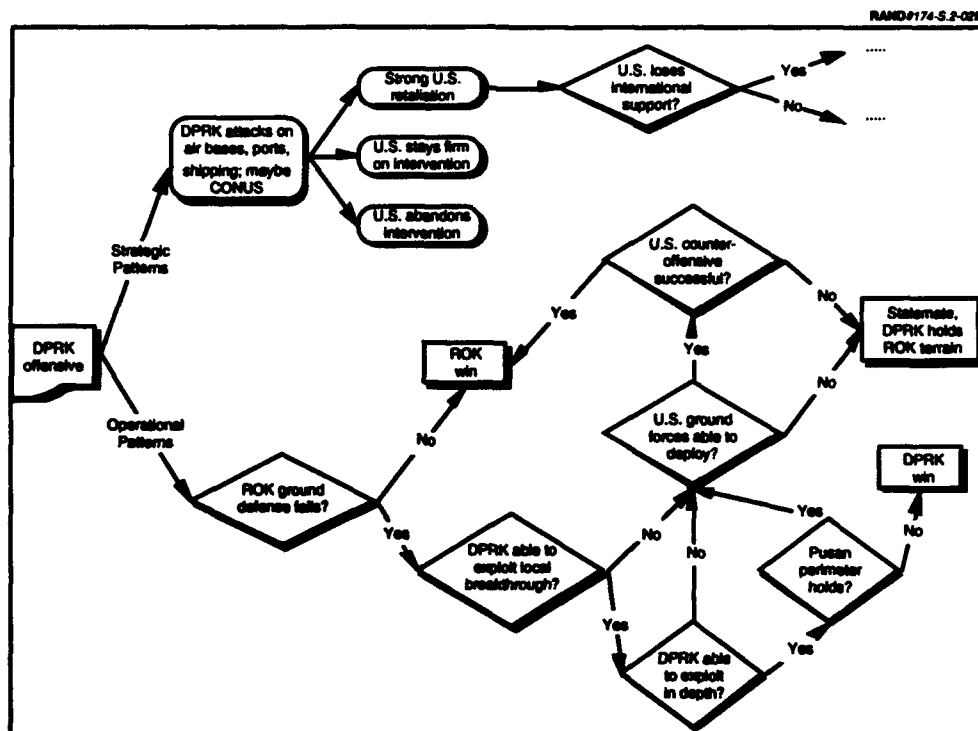


Figure S.2—Following Strategic/Operational Events: A Simplified Example

war will be exceptionally bloody and to test our willingness to sustain casualties. At the operational level, we focus on issues such as whether the ROK forward defense fails; if it does, then the future course of the conflict is fundamentally different, and the United States is faced with both operational and strategic issues.⁵ In either case, the analyst needs to understand what conditions could lead to the specified events, how they might be prevented, and how the outcome is affected by the various uncertainties.

Analysis focused on strategic and operational events must, therefore, perform three tasks:

1. Define the prospective events and the sequences in which they might occur. These tend to be based on the objectives of each side. Can an aggressor threaten the potential for U.S. intervention, and if so how? What are the key operational events (breakthroughs, exploitations, or failed attacks) that might happen in the theater?
2. Determine the circumstances that might cause the events, and how they might be prevented or promoted. For example, what kind of North Korean operation might cause the forward defense in South Korea to fail, how would force levels and performance on each side affect this result, and what other actions can be taken to promote or threaten the defense?
3. Determine the likely implications of the events. For example, if the forward defense in Korea fails early, it might affect the U.S. decision on involvement, change the character of the resulting operations (perhaps denying South Korea a fall-back defensive option), and change the kind of analysis needed to determine the result of subsequent operations (from an assault to an exploitation).

In addressing these issues, the military operations expertise and strategic awareness of the analyst become his key qualifications, whereas historically many analysts had more expertise in operations research than in military operations.

⁵On the strategic side, the analyst must assess the implications on U.S. will if the defense fails within a day or two of war initiation versus the implications if the defense holds for much longer or never does fail. While a U.S. decision to intervene would never be determined on this issue alone, it would likely be a contributing component to either the initial decision to intervene or a reassessment of that decision based on the course of events in the theater.

The Counter Capability Framework

It is difficult to predict a threat environment for any regional conflict given the uncertainties of the participants, the doctrine and operations they might employ, the new military technologies they might have acquired, their military force structure that might evolve by the time they engage in the contingency, etc. Such uncertainties make it difficult to do analysis based only on intelligence estimates of the developing "threat." Rather, if an adversary seeks aggressive operations that they believe will eventually involve the United States, logically it should have prepared for such a conflict by developing capabilities to counter the well-known U.S. strengths. Above, we proposed using a threat menu to define the range of actions that an opponent might take.

To develop threat menus, we propose using a counter-capability framework,⁶ which begins by positing that the U.S. strengths are known to our prospective opponent(s), and that given the initiative, those opponents will attempt to posture themselves and orchestrate future conflicts in ways that counter U.S. strengths.⁷ It proceeds to characterize the kinds of counters that could be used against U.S. strengths (including how effective the counters might be and any limitations that might exist on cases or environments in which such counters might apply), determines the likelihood that prospective opponents might succeed in developing and applying such counters,⁸ and examines ways in which the United States might deal with such counters. The counter-capability framework thus considers aggressive and potentially diverse adversaries, and how they might interact with the United States through peacetime competition and wartime operations.

Table S.2 shows some of the types of counters that could be applied to overcoming U.S. air superiority—a clear U.S. strength.⁹ We identify four types

⁶An earlier version of this counter-capability framework was printed as, Bruce Bennett, "A Counter-Capability Framework for Evaluating Military Capabilities," *RSAS Newsletter*, RAND, February 1993.

⁷The presumption is that future potential enemies of the United States could employ thought processes along the lines of DoD's work on "competitive strategies."

⁸For example, the most direct counter to U.S. air power would be strong air forces developed by our prospective opponents, but air power is a difficult capability to cultivate, and most prospective U.S. opponents appear unlikely to make much progress in this area. Alternatively, ballistic missile technology appears much easier for most of our prospective opponents to develop and potentially apply against U.S. air bases. Thus, the counter-capability framework is a forward-looking approach that suggests kinds of counters that each side may employ, and the potential ability of various countries to do so, without focusing on the threat posed by any single foreign country.

⁹This structure was originally proposed in Sam Gardiner, "It Isn't Clear Ahead, But I Think I Can See the Edges of the Road: The Character of Future Warfare," *RSAS Newsletter*, RAND, November 1992.

Table S.2
Some Possible Opposition Reactions to U.S. Air Superiority

| Type of Counter | Example | Likely Impact |
|-----------------|--|---|
| Parallel | Air-to-air engagements | Expect opposition will enjoy few successes and suffer major losses because of their poor pilot quality and, in many cases, poor aircraft |
| Direct | Surface-to-air missiles | Expect some U.S. losses and virtual attrition |
| Indirect | Hardening | Works well for some forces and facilities but not for others (e.g., ground forces that must move or the electrical power system) |
| | Dispersing, hiding facilities | Will protect some facilities and forces against U.S. intelligence collection |
| | Urban location of targets | May make the potential of collateral damage sufficiently high to preclude U.S. targeting |
| Asymmetrical | Air base attack | Most likely procedure for seriously disrupting U.S. air forces—could be very effective if a combined missile and SOF force are employed |
| | Denial of regional bases | If air base attacks are successful, denial of regional bases would largely prevent the United States from bringing air power to bear in the theater |
| | Denial of littoral access by carrier battle groups | In areas with constrained waters, may be able to impose a standoff by naval forces that limits their involvement in the air war |

of counters: parallel (confront the capability with matched forces), direct (directly engage the capability with other forces), indirect (passively protect against the capability), and asymmetric (attack the forces on their bases or attack their support system). Included here is an initial appraisal of the likely effectiveness of each counter; these counters then become an important part of a threat menu.¹⁰ Since this generic table does not identify a specific opponent, it

¹⁰See, for example, Bruce W. Bennett, *Global 92 Analysis of Prospective Conflicts in Korea in the Next Ten Years*, N-3544, 1993 (especially Appendix B).

obviously could be revised and made specific to certain prospective opponents. These counters then need to be examined in more detail. For example, the United States could respond to air base attacks with ballistic missiles by employing enhanced Patriot missiles or the eventual Theater High Altitude Area Defense (THAAD) system, which, in turn, could be attacked by the adversary using special operations forces (SOF) (firing mortars or rocket propelled grenades [RPGs] at the defense radars), etc. The analyst iterates this process until the possible battlefield development options become clearer.

Simplified Models

A range of simple models needs to be developed to address the conditions in which operational and strategic events might occur. The scope of these models would necessarily be wider than most theater-level simulations today, as they would include issues such as the effects of SOF attacks, operations of mobile missiles, the impacts of attacks on ports and airfields, the effects of logistics interdiction, and the effects of chemical and biological warfare. The models may be relatively simple in the sense that we are seeking an analysis of conditions in which key events might occur, and a simple model would be adequate if it could reach conclusions on military trade-offs. These models may come more in the form of a look-up table based on expert judgment rather than a formal model; for example, we might conclude that fewer than 5 SOF teams committed to interdicting logistics flows in Korea will have negligible effects, but more than 50 deployed teams could have substantial effects on oil and munitions flows.

Simplification is facilitated in circumstances where the United States would have "operational dominance," a condition in which it is so superior in some area that its use of military force in that area is largely unopposed by enemy forces. If one wished to analyze a future conflict in which the United States was expected to have the kind of operational dominance of the air that it had in Operation Desert Storm, it would make little sense to perform sophisticated air-to-air combat analysis of such an operation; indeed, the opponent would be more likely to deny such battle the way the Iraqis did in Operation Desert Storm (by not flying). In such a case, a very small percentage of losses per sortie or an assumption of essentially no losses would likely be adequate to cover air attrition.

The Implications of "Regional" Weapons of Mass Destruction¹¹

Consideration of "regional" weapons of mass destruction needs to become an integrated part of regional contingency analysis. Regional assessments need to begin by establishing different boundaries and constraints in environments where weapons of mass destruction are known to exist or may exist: Conventional operations will simply not proceed without first considering these possibilities.

The potential U.S. interest in preempting the use of weapons on mass destruction in future conflicts requires analysts to have available models and data of preemptive strikes against the nuclear capabilities of regional powers, including the likelihood of our knowing the location of the nuclear infrastructure.

Further research is required into the potential impact of nuclear detonations on U.S. forces early in their deployments and on a U.S. counteroffensive (likely targets of an opponent's attack).

Finally, we need better models of chemical and biological attacks, including both immediate casualties and the effects on military operations thereafter.

Addressing the Uncertainties

The military analysis community needs to adapt to an era of uncertainty by developing better procedures for representing uncertainties. Quantitative estimates of uncertainty are hard to assimilate, but single-point estimates of contingency outcomes can be dangerously misleading. If nothing else, simply the description of the results of analysis must change to terms such as:¹²

- The addition of two divisions only modestly (or significantly) affects the ability of the defender to hold terrain [the relative magnitude of results].¹³

¹¹The results of some of our games in this area are reported in Sam Gardiner, "Playing With Nuclear Weapons," *RSAS Newsletter*, RAND, February 1993, and Daniel B. Fox, "Atoms for Peace," *Military Science & Modeling*, August 1993. Some of RAND's other work in this area is found in Marc Dean Millot, Roger Molander, and Peter Wilson, "The Day After . . .": *Nuclear Proliferation in the Post-Cold War World—Volume 1: Summary Report*, MR-266-AF, RAND, 1993; Roger C. Molander and Peter A. Wilson, *The Nuclear Asymptote: On Containing Nuclear Proliferation*, MR-214-CC, RAND, 1993; and Bruce Bennett, "Countering North Korean Nuclear Proliferation," *Military Science & Modeling*, August 1993.

¹²These are taken from Bruce W. Bennett, et al., *RSAS 4.6 Summary*, N-3534-NA, RAND, 1992, p. 26.

¹³After each example, we state the more general type of issue addressed inside brackets, to clarify what we feel to be the kind of results appropriate for presentation.

- The addition of two divisions allows the defender to hold terrain better if these divisions arrive before D+10 (10 days after the start of the conflict) in the theater [the robustness of the results].
- The addition of two divisions only modestly affects the ability of the defender to hold terrain, but adding an independent attack helicopter brigade to each corps across the front would significantly affect the ability of the defender to hold terrain, assuming attack helicopters can average at least 0.5 combat vehicle kill per sortie [the relative value of different force commitments].
- The addition of a new air defense weapon in a sector substantially increases the attrition caused to opposing attack helicopters, which in turn reduces the long-term damage the helicopters can cause. It reduces the likelihood that the opponent will achieve a breakthrough and substantially reduces the destruction he could cause if a breakthrough is achieved [the interactions of factors].

In addition, analysts need to help decisionmakers develop strategies for managing the uncertainties, such as hedges, avoidance, etc. The statements above suggest some such procedures, but a more rigorous approach to managing uncertainties needs to be developed.

Modeling Issues

The new approach to the analysis suggested above would place three specific requirements on military modeling: (1) developing procedures for more fully capturing the courses of strategic and operational events that might occur, such as shown in Figure S.2, (2) defining a wide range of simple models to address these events, and (3) including procedures for reflecting the strategic and operational variables that characterize different warfare environments in these models.

Models must include explicit reactions to undesired battle outcomes. For example, if air forces suffer 3 percent attrition, operating procedures will likely be modified to reduce such losses, even at the cost of effectiveness against targets.

Military models must facilitate the sensitivity testing of threats and other warfare uncertainties. Thus, they must be relatively fast running, easy to modify to different uncertainty cases, and have outputs that make examination of the sensitivity runs meaningful in terms of both overall differences in results and the implications of the sensitivities on specific key events (like breakthroughs). The

models should not be treated as rigorously quantified but rather as a vehicle for considering the uncertainty ranges.

Further work is also required to better represent personnel attrition and collateral damage to civilians.

Conclusions

The central purpose of this report has been to argue the need for developing military analysis and modeling so as to better reflect the likely nature and circumstances of the major conflicts in which the United States could become involved in the post-Cold War world.

We have sought to illustrate some of the deficiencies of current modeling and analysis techniques and to indicate how the evolving nature of future warfare will widen the gap between reality and our current methods and tools for representing it. Central to this process will be the likely determination of any future U.S. adversary to avoid a rerun of Operation Desert Storm by using innovative methods to counter key U.S. military capabilities and by seeking to manipulate the political and strategic context of the conflict. This method will introduce new uncertainties, variables, and asymmetries into future warfare that analysis and modeling must try to comprehend. We have suggested some new approaches; but the underlying requirement is for a better basis of military science from which to perform modeling and analysis and a better grasp of the future of warfare.

We accordingly recommend that the DoD: (1) pursue the development of military science; (2) develop a shared understanding of the future of warfare within DoD by research, wargaming, and discussion seminars; and (3) adopt new analytic procedures appropriate to the changed MRC environments we face. The new analytic procedures need to reflect the significant differences in warfare environment that will exist between theaters; to focus on strategic and operational events, variations, and uncertainties; to adopt a "counter-capabilities" approach to defining military threats; to adopt a new approach of developing simple but more comprehensive models; and to develop new procedures for presenting the uncertainties of their analyses to decisionmakers. We also note that the changed warfare environment requires a shift in the priority of capabilities among analysts: For the foreseeable future, analysts must possess an understanding of the range of possible military operations and how they fit into strategic contexts (such capabilities being far more important in an era of uncertainty than are detailed quantitative skills).

Acknowledgments

The authors are grateful for the guidance, suggestions, and support provided by Mr. Andrew Marshall, the Director of Net Assessment in the Office of the Secretary of Defense (OSD/NA). The audiences to which this material has been briefed, both in the Department of Defense and at RAND, have provided many useful comments that have helped clarify and strengthen this material. The authors appreciate the effort of Christopher Bowie in formally reviewing this draft and also the courtesy of informal reviews provided by RAND colleagues Lieutenant Colonel Russell Glenn, Bruce Pirnie, and Barry Wilson.

Glossary

| | |
|----------------|--|
| ADA | Air Defense Artillery |
| APOD | Aeroport of Debarkation |
| ATACMS | Army Tactical Missile System |
| AWACS | Airborne Warning and Control System |
| BAI | Battlefield Air Interdiction (air interdiction behind CAS but within 100 kms or so of the front) |
| CAS | Close Air Support |
| CEP | Circular Error Probable |
| CFC | Combined Forces Command, which unites U.S. and South Korean forces |
| C ³ | Command, Control, Communications |
| DMZ | Demilitarized Zone |
| DPRK | Democratic People's Republic of Korea (North Korea) |
| EW | Electronic warfare |
| FAE | Fuel Air Explosive |
| FEBA | Forward Edge of the Battle Area |
| FOG-M | Fiber-Optic Guided Missile |
| GOP | Guard Outpost Position (on the southern edge of DMZ in South Korea) |
| ICBM | Intercontinental Ballistic Missile |
| ID | Infantry Division |
| JSTARS | Joint Strategic Target Attack Radar System |
| kph | kilometers per hour |
| LRC | Lesser Regional Contingency |
| MDL | Military Demarcation Line (center of DMZ in Korea) |
| MRC | Major Regional Contingency |
| MRL | Multiple Rocket Launcher |
| NBC | Nuclear, Biological, and Chemical weapons |
| ODS | Operation Desert Storm |
| OSD/NA | Office of the Secretary of Defense / Net Assessment |
| POL | Petroleum, Oil, and Lubricants |
| PRC | People's Republic of China |
| ROK | Republic of Korea (South Korea) |
| RPG | Rocket Propelled Grenade |
| RSAS | RAND Strategy Assessment System |
| SAM | Surface-to-air missiles |

| | |
|-------|--|
| SOF | Special operations forces |
| THAAD | Theater High Altitude Area Defense (an antiballistic missile system) |

1. Introduction

This monograph report describes work done as part of the development of the RAND Strategy Assessment System, an initiative of the Director of Net Assessment in the Office of the Secretary of Defense to improve the procedures used for analysis and modeling of major regional contingencies and higher-level conflicts.

The work included in this report has involved war gaming and analysis, has spanned the spectrum of major force operations, and has considered both the present and future of warfare.

Purposes and Context

The purposes of this report are

- To define how military analysis and modeling have failed to match the conditions of war in major regional contingencies (MRCs), primarily because of a failure to develop an appropriate military science as the background for analysis and modeling (Section 2)
- To show our perceptions of the future of war. We do so by discussing some of the observations derived from our future of warfare war games (Section 3) and by characterizing our impressions of the future of warfare based on both our gaming and analytic work (Section 4)
- To recommend the appropriate direction for military analysis and modeling in response to the existing divergences and the future trends in war (Section 5).

Setting the Context

Figure 1.1 defines the context for our analysis of theater modeling. It refers to the relative amount of physical science, other quantitative factors, and qualitative factors in various levels of military analysis and modeling. The four levels of modeling identified are (1) engineering (one tank firing on another tank or a surface-to-air missile flyout toward an aircraft), (2) engagement (a brigade or regiment's attempt to create a tactical breakthrough by assaulting an opposing

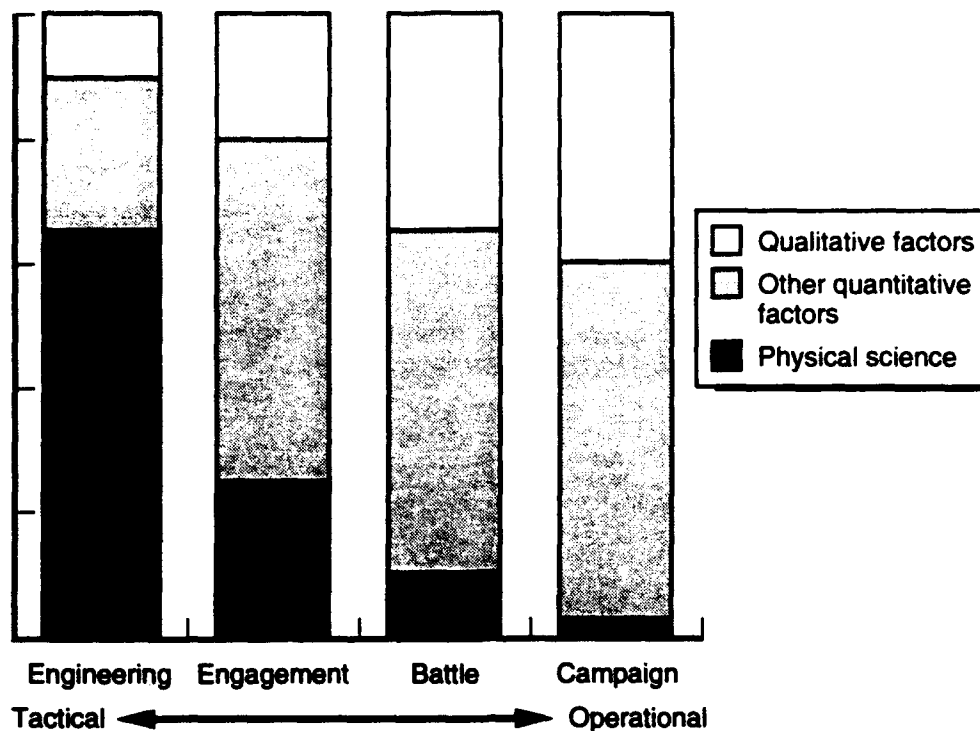


Figure 1.1—Setting the Context

battalion or a submarine group attempting to penetrate through escort ships to attack merchant shipping or a carrier), (3) battle (a North Korean corps' or army's attempt to penetrate the South Korean defenses in front of Seoul or a combined-arms enemy effort to suppress the operations of coalition air forces from air bases within a theater), and (4) campaign (Operations Desert Shield/Storm).¹ Theater-level modeling is done primarily at the battle/campaign levels—or what is otherwise called the operational level of modeling.

The operational level of modeling sharply contrasts with the tactical level of modeling, and in particular with engineering analysis, because of the relatively small content of physical science in operational-level analysis.² At the engineering level, the high content of physical science gives a relatively rigorous basis for theory and modeling relationships (although quantitative issues, such as the speed of reloading a tank gun, must still be considered). Even at the

¹See Bruce W. Bennett, "Defining a Structure for Analyzing Major Regional Contingencies," *RSAS Newsletter*, RAND, February 1993.

²The relative quantities shown here are somewhat arbitrary; no real quantification of the factors in Figure 1.1 has ever been accomplished. Rather, the numbers here are intended to show the relative patterns, without claiming to be precise.

engagement level, physical science no longer dominates the analytic structure, and the analyst and modeler are left without an appropriate basis for theory without an appropriate military science. This pattern becomes more pronounced at the operational (theater) level. In addition, the growing significance of qualitative factors makes operational-level analysis inherently more uncertain.

To illustrate the issues here, if an analyst wishes to determine the impact point of a bomb dropped at a specified point from an aircraft flying at a given speed, he can employ broadly accepted equations that are understood throughout the community. Alternatively, if an analyst wishes to estimate the impact of that bomb drop on a battle, only limited military science exists that defines even what the key variables are, let alone their relationships. As a result, different analysts and different models use different and often inconsistent procedures, and not even a framework is available for examining these differences and the implications they should have.

2. How Warfare Has Diverged from Military Analysis and Modeling

Even during the Cold War, the analysis and models of theater conflict were only approximations of the kinds of conflict that would likely occur. The divergences were primarily in terms of poor representations of the relative operating characteristics of Soviet forces and the forces of their Warsaw Pact allies, inadequate bases for calculating battle outcomes, little or no connection between logistical support and the ability of forces to perform their combat operations, and a lack of representation of qualitative factors such as training and national proficiency. The community spent some effort attempting to address Soviet operating characteristics, but no military science was ever developed that was adequate to resolve these issues.

The end of the Cold War and the ascendancy of regional conflicts have not simplified these problems. This section addresses a few of the existing problems in the theater analysis and modeling community today that have caused the divergence between warfare and military analysis/modeling to grow.

Discontinuities in Warfare

One reason for the divergence between theater warfare and military analysis/modeling is that the operational and tactical levels of warfare are different, and yet most analysis and modeling activities are based on tactical-level assumptions. In a recent paper,¹ we identified some of the existing discontinuities between the operational and tactical levels of warfare. Consider the issue of military movement rates. For example, an individual tank can run at 60 kilometers per hour (kph) for an extended period of time. A tank company can move at about 25 kph for most of a day. A tank division can move at most an average of 5 to 7 kph sustained over a day. Most analysts would not build a theater simulation model that showed divisional movement rates based on aggregating individual tank movements; in other cases, however, tactical rates get extended to operational situations (particularly true for attrition rates). In almost no cases are the thresholds of these discontinuities clearly defined, the reasons for the

¹Bruce Bennett and Patrick Allen, "The Discontinuity in Theater Analysis and Modeling," *Military Science and Modeling*, May 1993, pp. 2-8.

discontinuities examined in detail, or rules developed for properly reflecting the results on either side of the discontinuities.

As another example, almost all ground combat models (including theater models) assume that difficult terrain favors the defender. At the tactical (engagement) level, cover and concealment afforded by difficult terrain tend to ensure such a relationship. At the operational level, however, difficult terrain tends to limit the opportunities of the defender to counterattack against the attacker and thus tends to favor the attacker.² Clausewitz said: "... we have pointed out ... that in a decisive battle, mountainous terrain is of no help to the defender; on the contrary, that it favors the attacker. This is the direct contradiction to the general opinion; but the general opinion is usually in a state of confusion. ..."³

Similarly, most theater combat models assume that the defender has the advantage in any given engagement, in large part because of the defensive preparations he can erect. However, history shows that attackers with similar size forces often defeat defenders, implying that the advantage of initiative and momentum can be decisive for the attacker, especially at the operational level. From the operational perspective, analysis and models somehow need to reflect that in battles, the advantage may well accrue to the attacker and not always to the defender.⁴

Many models of tactical operations assume continuous combat during the period covered by the model (the duration of an engagement). However, battles and campaigns are not continuous; indeed, the very character of battles and campaigns is determined by their discontinuous events such as breakthroughs, failed attacks, loss of control, etc. But no military science supports predicting these events; thus, many theater-level models ignore them and assume continuous combat operations. The result is often a simulated course of events that is incredible (e.g., an army mounting a 30-day assault of continuous intensity

²Alternatively, the United States appeared to gain great advantage from the open terrain in Operation Desert Storm, but that advantage seemed due more to superior capabilities for maneuver, intelligence collection, and tactical/operational fires. Once the first U.S. corps was in place in Saudi Arabia, one can argue that the United States would have enjoyed similar advantages on the defensive (had Iraq been foolish enough to attack at that point) because of the same superior capabilities.

³See Carl von Clausewitz, *On War*, edited and translated by Michael Howard and Peter Paret, Princeton University Press, 1976, Princeton, NJ; p. 423. This and related issues are discussed in Samuel Gardiner, "The Logic of Operational Art," *RSAS Newsletter*, RAND, November 1992.

⁴For example, Trevor Dupuy describes a number of historical battles and finds that, "In fact, in most of the examples shown in Figure 1-7 the successful attacker was actually outnumbered by the defender." T. N. Dupuy, *Numbers, Predictions, and War: Using History to Evaluate Combat Factors and Predict the Outcome of Battle*, The Bobbs-Merrill Company, Inc., Indianapolis, IN, 1979, p. 12. We made a first attempt at depicting initiative and momentum in: Bruce Bennett, "Ground Combat C3I Effects," *RSAS Newsletter*, RAND, January 1992, pp. 17-22.

on a given defensive position), although the results of such simulations are still often touted as authoritative.

Qualitative Factors, Uncertainties, and Combined Arms

Existing analytic approaches and modeling procedures also do not adequately handle some difficult issues such as qualitative factors, uncertainties, and combined arms operations.

Some would argue that since qualitative factors are sufficiently difficult to capture, they are best ignored, and we should not do analysis where such factors are of significant importance. If the relationships in Figure 1.1 above are even close to being correct, this approach would imply that we could not do theater-level analysis (since qualitative factors are such an important component in the total assessment). However, in many cases analysts have been able to at least approximate qualitative factors and show the degree of difference that they might make (recognizing the inherent uncertainties). Indeed, both recent and historical conflict situations have shown that qualitative factors such as training, proficiency, doctrine, and force cohesion can often be more important determinants of theater conflict outcomes than the quantitative factors such as force size.⁵ But few theater-level models include procedures for reflecting these factors, and those that do lack any kind of consistent underlying military science.

At the theater-level, not only are the qualitative factors uncertain, but also many of the relationships between quantitative factors are quite uncertain. And yet many theater-level models still strive for single, point answers rather than describing the range of potential outcomes. This in part reflects a limitation in the analytic framework for examining warfare: neither analysts nor decisionmakers seem prepared to work in terms of uncertain outcomes.⁶

Finally, military analysis has for years been dominated by the assumption that most assessments of military capability can use linear methods of aggregation.

⁵See, for example, the work of T. N. Dupuy, *Numbers, Predictions, and War: Using History to Evaluate Combat Factors and Predict the Outcome of Battles*, The Bobbs-Merrill Company, Inc., Indianapolis, IN, 1979, especially pp. 133-135 on the Israeli experience, and 102-110 on the German experience.

⁶For example, instead of stating a conflict outcome such as, "The opposition forces will be stopped at 12 kilometers from the border," the magnitude of uncertainties in theater-level analysis require us to think in terms of outcomes such as, "The opposition forces will likely be stopped before they advance 15 kilometers, unless they are successful in limiting defender response time, or defensive air force effectiveness, or . . . , in which case the attack could reach a depth of at least 80 kilometers," or "While a reasonable estimate of the campaign outcome is an advance of only 20 kilometers, this outcome is totally dominated by the uncertainties, which make even an attacker breakthrough a possibility."

For example, simple measures of ground force capability involve estimating the value of different weapon systems and then aggregating that value times the number of systems of the given type. This assumption is equivalent to saying that some number of small arms is precisely substitutable for a tank or artillery piece. The reality is that almost all forms of military operations involve potential synergisms between differing weapon systems that usually are referred to as combined arms effects (for example, having enough artillery to properly support an armored assault). The community lacks a framework for estimating such synergisms. At the higher level, analysts must also consider the implications of joint and combined operations, which in some cases will yield synergisms (e.g., air forces supporting ground forces) and in other cases will involve degradation of capability (e.g., ground forces of one coalition nationality not being able to effectively communicate with the neighboring ground forces of another nationality).

Addressing These Problems

We would not want to imply that no efforts have been made to address these problem areas. As part of the RSAS effort, for example, we have developed procedures for dealing with many of the problems, including:

- Attrition rate adjustments for battles involving forces of differing sizes
- Explicit representations of phases in a campaign
- Simple models of breakthroughs, attack failures, and other posture changes
- Adjustments for qualitative factors such as national proficiency (in various areas), training, cohesion, mission specialties, and the value of initiative and momentum
- A design for sensitivity testing and a recommended analytic approach that focuses on uncertainties
- Combined arms effects represented in the situational force scoring methodology
- Special rules for air-ground force interactions
- Multipliers for reflecting the effectiveness of joint and combined operations.

However, the RSAS efforts do not yet constitute a military science, despite our efforts to disseminate our work, and other researchers might well adopt different approaches or ignore these factors all together.

3. Gaming Observations on the Future of Warfare

To better understand the potential future of warfare, we have performed a series of innovative future of warfare games.¹ These games were organized to examine how potential U.S. opponents might choose to posture their military forces and how they might employ them to defeat U.S. allies and perhaps even U.S. forces in major regional contingencies. By determining the resulting potential threat to U.S. security interests, we are then better able to understand the U.S. military requirements for future wars and also understand how warfare might evolve. Over the past 24 months, we have conducted nine such games at RAND on major regional contingencies (four in the Persian Gulf, including one that focused on disabling weapons;² three in Europe, including one focused on applications of future technologies; one in Korea; and one concurrent conflict involving Korea, the Persian Gulf, and Cuba).³ We supported games in four theater areas for the Global 92 war game, one theater area in the Global 93 war game, and have worked on several dozen other war games associated with the senior service colleges (especially at the National War College). The research reports that have been completed on these games are identified in the References section.

The most important contribution of the games we have played is that we have forced ourselves to look at the other side. We have looked at how other nations might react to United States objectives and constraints. We have looked at how

¹These games are described in some detail in Bruce W. Bennett, Margaret Cecchine, Daniel B. Fox, and Samuel Gardiner, *Technology and Innovations in Future Warfare: Wargaming the Persian Gulf Case*, N-3603-NA/OSD/AF/A, RAND, 1993. These games were not the typical scenario-oriented move/countermove kind usually associated with the term "war game," and so we will refer to them herein as "games" rather than "war games." The players in these games have been a combination of military officers (usually at the Colonel/Captain and Lieutenant Colonel/Commander levels) and comparable level civilians; they came from assignments at the services, the Office of the Secretary of Defense, the Joint Staff, the senior service colleges, the intelligence community, and RAND.

²Disabling weapons are intended to prevent the employment of military forces, rather than to destroy them, and as a result are sometimes referred to as nonlethal weapons. For example, a chemical that causes fuel to turn to jelly would be a disabling weapon because it would prevent opposing vehicles from being able to move. While so transforming fuel to jelly should not kill opposing forces directly, it could lead to their death because they are thus isolated from supplies or face other threats. Thus, such a technology is only nonlethal in terms of direct effects. See Sam Gardiner, "The Nonlethal Revolution in Warfare: Maybe Not Such a Revolution," *Military Science & Modeling*, May 1993; Sam Gardiner, "Even Nonlethal Weapons Might Kill the Notion of Peacemaking," *Military Science & Modeling*, RAND, August 1993.

³We have also done a number of war games on peacemaking in both lesser and major regional contingencies in recent months—see, for example, Sam Gardiner, "Playing with Mush: Gaming Lesser Contingencies," *Military Science & Modeling*, RAND, November 1993.

other militaries might react to U.S. forces and doctrine. We have focused on the two-sided character of war.

Games provide one basis for examining potential future conflicts. As noted in this section, at times we can expect that games may not well reflect the future, often because it is hard to predict with any precision the environments that will develop. Also, the players available for such games are not perfect surrogates for the leaderships of likely prospective opponents. Still, games can suggest some patterns that are then useful to examine further through other analysis. The next section is the result of such further analysis.

Setting the Conditions and Objectives for War

In the wake of Operation Desert Storm (ODS), and with the dissolution of the Soviet Union and the sharp subsequent reductions in the militaries of the new states that used to comprise the Soviet Union, the United States has become the predominant conventional military power in the world.⁴ While a few countries still field more ground force divisions and manpower than the United States, the quality of the U.S. forces and their combined arms capabilities—in combination with the alliances the United States maintains and its ability to lift U.S. forces around the world—gives the United States an ability to bring overwhelming force to virtually any “regular” conventional regional conflict in the world,⁵ if it has sufficient time and the will to do so. Despite the planned reductions in U.S. military forces, technological innovation should help the United States sustain these capabilities well into the next decade.

The dominance of U.S. forces set the framework for our games. In almost every case, the opposition players recognized this dominance, and it shaped their preparation for conflict. The perceived strength of the United States meant that prospective opponents in major regional contingencies (with the level of conflict set above insurgent operations) could not plan to militarily defeat the United States in conventional, regular combat that lasted long enough for the United States to effectively project forces (i.e., beyond about one month).⁶ U.S. military power thus conveys a high level of deterrence. Despite that deterrence, if U.S.

⁴The United States also appears predominant in its nuclear capabilities.

⁵Unfortunately, some current and prospective U.S. adversaries appear determined to pursue irregular (guerilla) warfare, a form of warfare in which the United States is not predominant. RAND is working on characterizing U.S. peace enforcing efforts to better understand the differences that irregular warfare make on U.S. power projection.

⁶This perception is extremely strong among most of the senior officers who have been involved in our games. It is undoubtedly affected by the ODS experience and may be a bit stronger than warranted.

adversaries wish to achieve gains that can only be accomplished through military means, the players felt that they must dissuade the United States from becoming involved or attack U.S. will and ability to intervene once the United States does become involved. Part of this approach involved attempting to act with strategic surprise to catch the United States unprepared to respond. Another part involved rapidly achieving some or all of their objectives—within a few days or at most a few weeks—before the United States could mobilize its power and project it into the theater of operations. Opposition players considered creating terminating conditions that would be acceptable (or at least preferred to military intervention) to at least some within the United States.

“Blue” players felt that the United States no longer perceives a threat to its survival as it did during the Cold War. Such a threat simplifies one’s grand strategy: Survival is an absolute imperative. By contrast, the lack of such a threat implies that the objectives of U.S. military operations will be limited in the future (for example, in ODS, the U.S. objective was to restore Kuwaiti independence, the flow of Gulf oil, and the regional balance of power;⁷ the United States did not perceive a threat to its national survival). In turn, limited objectives imply that the United States will have to address basic trade-offs when becoming involved in future conflicts: Are the losses and risks it will incur justified by the gains it may achieve? How many American lives and how much cost are the United States willing to trade to ensure the security of any specific foreign power or bring stability back to a given region? Limited U.S. objectives thus sets a framework against which opponents can operate to deter U.S. involvement or cause a U.S. decision to terminate involvement. Ultimately, only the U.S. President and Congress will make this decision, and their decision will be heavily influenced by how they personally feel on such trade-offs and how they react to the judgements of the media and public opinion (thus, who these leaders are makes a difference).

The sensitivity of the United States to personnel losses—historically, in ODS, and now in Somalia—provides an obvious focus for attacks by opposition forces seeking to undermine U.S. will. In our games, players considered using or threatening the use of terrorism, weapons of mass destruction, and other high visibility weapons (such as Scuds or the submarines that may become a threat in the Persian Gulf). Players were willing to pay a high price in terms of their own losses to cause high U.S. losses and were fairly insensitive to the loss exchange ratio.⁸ In addition, the culture of at least some prospective U.S. opponents views

⁷While these objectives were limited, the United States still perceived them as vital.

⁸Such a strategy eventually worked for the U.S. opponents in Vietnam.

revenge as acceptable and expected, perhaps prompting them to attempt to impose some losses on the United States.⁹

Alternatively, some players felt that it was far preferable to avoid causing large U.S. personnel losses during the early stages of the conflict for which the U.S. may feel it would have to respond. Other players considered a nuclear detonation over the first Marine or Army forces debarking at an airfield or a combined arms attack against an established U.S. air unit in the region. While players felt that the United States would reevaluate its involvement in such circumstances, they were uncertain as to whether it would undermine U.S. will or backfire and lead to a stronger U.S. commitment.

The difference here is illustrated by the Japanese attack on Pearl Harbor that enraged the United States and committed it to World War II versus the terrorist attack on the United States Marines in Beirut that caused the United States to withdraw. Some analysts have argued that a large part of the difference between these two cases is a clear sense of national interests and objectives in the Pearl Harbor case (the solution to stopping the Japanese was clear though difficult) versus a poor sense of the same issues in Beirut. The clarity of solution in future major regional contingencies will be muddled by perceptions of the ODS outcome (and despite the U.S. limited objectives): Did the United States really solve the Iraqi threat in ODS, or did it simply provide a temporary resolution that will fester (such as with Saddam Hussein continuing to control Iraq)?

Another part of the difference was reflected in the players' normal feeling that opponents would not attack targets within the United States even if they could (because such attacks would likely strengthen the U.S. will to respond) but that opponents should only consider targets within the theater and en route to the theater; it is less clear that prospective U.S. opponents would feel that way, especially given their cultural differences and their attitudes toward revenge. Probably the U.S. response to casualties will also be a function of how the attrition occurs (e.g., the sinking of a cruiser by a mine may have a different impact than opposition special operations forces [SOF] shooting U.S. soldiers), the potential for recurrence of the attrition (e.g., if one cruiser has been sunk by a mine, other ships could be as well), and who has suffered the attrition (e.g., U.S. servicemen being shot may be different from U.S. civilians being shot).

The strength of the United States may force determined opponents into either reducing their regional objectives or expanding them significantly. For example,

⁹Thus, the ODS experience with taking civilian hostages could be repeated, or opponents might attempt to disrupt U.S. non-combatant evacuations.

in games where we have examined future conflict in the Persian Gulf, some Red teams have concluded that their objectives need to be very limited—perhaps no more than a few hundred-kilometer advance—in order to be achievable within a few days, during which time any major U.S. intervention may be difficult. Alternatively, other Red teams have concluded that they can only win by “securing the entire Saudi peninsula,”¹⁰ making even a medium-term U.S. intervention almost impossible. In the real world, the Red choice will likely turn on their perception of their capabilities; at the same time, this condition suggests that prospective enemies probably will try to develop power projection capabilities that would allow them to secure a broad objective area rapidly (and thus the development of capabilities such as air assault and amphibious forces and rapidly mobile ground forces should be a key indicator of potential intent).

In preparing to fight against the United States, opposition players recognized that they had to be prepared to trade their expected gains if successful in their operations versus the losses they might suffer. In particular, the U.S. emphasis on targeting strategic command, control, and communications (C³) suggests that it will attempt to threaten the survival of opposition regimes.¹¹ Most opposition players viewed regime survival as their foremost objective and thus found such a U.S. interest (and capability) very deterring; however, they were prepared in some cases to take extreme measures in response to such U.S. actions (see the discussion of third party nuclear weapons below), hoping to dissuade the U.S. from pressing such threats. We must consider alternative criteria for decisionmaking by future foes, such as cases in which U.S. opponents attack as a last desperate attempt to survive.¹² We also need to seriously consider the mismatch in objectives that may result from such campaigns, with the United States still having limited objectives but potentially having pushed its opponents into unlimited objectives.

¹⁰By securing the Saudi peninsula, usually the players have meant that they would occupy certain parts of the peninsula that they could reach quickly and then heavily damage areas (e.g., airfields and seaports) that they do not occupy to deny their use to the United States. They may also attempt to form a coalition to achieve this objective.

¹¹The United States may also threaten the survival of the opposing regime by destroying its economic infrastructure. Indeed, almost any form of strategic attack escalates U.S. objectives to theater strategic from theater operational, although the United States may lack an overall approach to a theater-strategic conflict resolution—which may become a problem, especially in maintaining domestic and coalition support, in future conflicts.

¹²One might argue that North Korea may be approaching such a point, as its economy seems headed for failure; a similar perspective contributed to the Japanese initiation of their involvement in World War II. We have found it very difficult for U.S. players to take this view, because they do not find themselves in desperate circumstances.

Opposition Preparation for Future Conflicts

There are few technologies that opposition forces can acquire to defeat the United States in future conflicts.¹³ Rather, the most important determinant of conflict outcomes appears to be how the war will be conducted, from creating the political context to the concept of operations. In the force structuring component of our games, we have purposefully pressed Red players to acquire a range of sophisticated weapon technologies before conflict initiation. When the players were directed to engage the United States and its coalition, the players concluded that weapon acquisition was third in importance behind the political context (which was most important) and the concept of operations.

Reflecting their experience with these games, most Red players have felt that they need to prepare over time for conflict with the United States. In particular, they have consistently sought to establish the political context for conflict in two dimensions: (1) reducing U.S. military power and influence and (2) selecting conditions for conflict initiation.

Setting the Political Context: Limiting U.S. Power

Potential future adversaries might seek to reduce U.S. military power and influence in two ways:

1. Reduce the size and capabilities of U.S. military forces by affecting U.S. interest in military affairs
2. Reduce U.S. strengths (political, economic, and military) through disruption.

These two goals would often be at odds. For example, if the world oil market faced a constant terrorist threat against oil shipments, U.S. attention and resources would likely be diverted to deal with such threats and thus be less available for major regional contingencies, but U.S. interest in military affairs would be heightened. Thus, challenge for the opponents would be finding the proper mix of efforts.

Our Red players have generally concluded that a benign world environment is most advantageous (one in which prospective U.S. opponents are relatively docile and give the appearance of cooperation in the international order), tending

¹³Only technologies such as intercontinental ballistic missiles (ICBMs) armed with nuclear weapons offer a clear potential for defeating the United States (assuming a lack of U.S. defenses and the United States does not preempt), but such threats still appear yet to be several decades off in most regions of the world.

to shift the U.S. focus inward on domestic issues. In turn, the U.S. domestic budget would tend to rise at the cost of further military cuts that appear warranted by the lack of international threats. To the extent that U.S. economic recovery does not occur or is slow, the resulting military cuts could become large and generally irreversible (at least within a few years), reducing the ability of the United States to intervene in future conflicts.

In some of our games, the players found that the many international frictions faced by the United States appear to be fertile grounds on which to disrupt U.S. strengths. For example, the disagreements between the United States and its major trading partners on trade practices could be aggravated by revelations of "unfair" behavior (from a U.S. perspective) and perhaps amplified into trade warfare by the natural forces developing around the world. Such developments would seriously impact the U.S. economy but generally would not heighten U.S. interest in military affairs. U.S. willingness to become involved in foreign conflicts could be reduced if the United States were to become entangled in some difficult and unresolvable lesser regional conflicts around the world. U.S. involvement in trade and military conflicts might then be turned to incite anti-American feeling among the populations of U.S. allies, putting further stress on U.S. forward presence and its ability to form coalitions.

Some opposition players also considered becoming involved in U.S. domestic politics. For example, cases may exist in which commitments of funds through third parties may affect U.S. political campaigns. While such actions carry a risk, they could also bring significant returns because of the importance of who the U.S. decisionmakers are at the time of the eventual conflict and because the U.S. decisionmakers will also determine the size and character of the U.S. forces as they evolve during the preparation period. Indeed, for opponents who can afford some amount of waiting, the election of specific U.S. decisionmakers might tend to be a more important condition for war initiation than the achievement of any given force structure or technology change.

Setting the Political Context: Developing Coalitions

One key element of ODS was the U.S. ability to form an international coalition. The political reasons for coalitions are likely to be compelling in many future MRCs, the benefits being greater international legitimacy ascribed to a collective action and the improved chances of maintaining domestic support if allies are seen to be bearing their share of the burden. The military arguments for acting as part of a coalition will also remain and may intensify. In ODS, the major fraction of the military power used in ODS came from U.S. forces. In our games, the U.S.

players found themselves more dependent on coalition partners in any given conflict, both because of the reductions planned in U.S. forces and because U.S. forces may not have the resources to resolve some key threats. For example, the U.S. may still have to rely at least in part on coalition partners to support any kind of broad-scale, naval, mine-clearing operation, and regional allies will be depended on for support infrastructure (including ports, airfields, and elements of resupply).

While not anxious to deal with this subject, the U.S. players usually came to recognize that they needed cooperation from regional countries to support U.S. operations in any given theater, especially if the United States must deploy into a hostile environment. For example, if North Korea could heavily interdict South Korean airfields, airfields in Japan, Russia, and/or the People's Republic of China (PRC) would be critical to U.S. operations in Korea. The failure to form an appropriate coalition may completely undermine the U.S. will and/or capability to intervene.

The warfare preparations of opposition players included efforts to undermine U.S. coalitions, as discussed above.¹⁴ Therefore, the U.S. needs to be very proactive in forming and maintaining relations with key allies essential to resolving prospective future conflicts. To the extent that U.S. attention turns increasingly toward internal issues, maintaining such relations will become more difficult.

The U.S. players also worried about the implications of combined operations in future coalitions. To the extent that coalition partners do not coordinate force operations with the United States in peacetime, the United States may have difficulty using a coalition with any degree of effectiveness. In ODS, the United States resolved combined operations problems in part by placing coalition forces with which U.S. forces were less well integrated into a single area of operations; the ongoing reductions in U.S. force levels may not give the United States that luxury in the future. Clearly, the United States needs to better understand the forces of its prospective coalition partners: how they operate, what their strengths and weaknesses are, and how they differ from U.S. forces. Investments of this sort, supported by joint and combined exercises and training, can significantly improve the effectiveness of future coalitions, and in cases perhaps help the United States make intervention decisions (for example, if it becomes

¹⁴U.S. opponents may be satisfied with simply delaying U.S. coalition formation, as discussed below.

clear that the U.S. forces available are insufficient to meet limited U.S. objectives).¹⁵

We also discussed possible opposition coalitions in several games and focused one game on this subject. Many of the prospective U.S. opponents around the world share common concerns and interests (in particular, a serious dislike of the United States) and thus have some basis for coalition formation. These common interests have appeared as part of weapon technology trades in the recent past, such as North Korean technological support of ballistic missile and other weapon developments in Syria and Iran. The Red players in our games did not feel that sufficient commonality of interests existed among prospective U.S. opponents for them to form a close alliance. They did, however, recognize the value of facing the United States with simultaneous contingencies and agreed that if (and only if) each party had reason to independently confront the United States, they have every reason to do so simultaneously.

While the United States has the ability to pursue major regional conflicts (MRCs) in many regions around the world, its ability is limited to do so in two or more MRCs simultaneously. This situation is implicitly recognized in the Administration's recent "Bottom-up Review" of U.S. forces for the post-Cold War world,¹⁶ in whose goal is the fielding of forces sufficient to fight and win two "nearly simultaneous" MRCs. It notes that in consequence "our plans call for substantial enhancements to our strategic mobility," including sea- and air-lift. The review also notes that "certain specialized high-leverage units or unique assets might be 'dual tasked,' that is, used in both MRCs." The implication is that the near-simultaneous eruption of two MRCs (as would be the case if adversaries concerted or one sought to capitalize on the initiative of another) would, at any rate in current conditions, pose some very severe problems to the United States. In such cases, the U.S. players felt that they would be forced to make serious trade-offs, which could either dilute U.S. effectiveness in each theater area or allow the U.S. opponent in one theater to achieve his objectives while the United States attempted to resolve the conflicts sequentially.¹⁷ Such

¹⁵A tremendous tension exists in such evaluations. If the United States properly evaluates the forces of prospective allies, it will undoubtedly identify quite a number of deficiencies (even U.S. forces have deficiencies). If these deficiencies become publicly known, however, U.S. confidence in the ally may be undermined to such a point that the United States is unwilling to support it.

¹⁶Les Aspin, *The Bottom-Up Review: Forces For a New Era*, Department of Defense, September 1993.

¹⁷The "win-win" or "win-hold-win" strategies assume that the United States can indeed handle these kinds of circumstances. The players in our games were less optimistic, assuming that the opponents would fight the United States on an asymmetrical basis, as discussed in more detail in Section 4.

conditions raise the intervention risks for the United States and as a result may undermine U.S. will (internal political resolve) to intervene.

Setting the Political/Military Context: Limiting U.S. Response Time

The opposition players in our games felt that starting conflicts with very short warning gave them an initial advantage on the battlefield (even at the cost of some degree of force preparations) because of the relative lack of forward U.S. deployment. Indeed, having the operational initiative may well be a deciding factor in at least some future conflicts, in which attackers are able to quickly accomplish their objectives and assume defensive positions from which the cost of expelling them may be perceived as too high. Short warning thus limits the ability of the U.S. or other countries to deny opposition objectives,¹⁸ likely driving the U.S. instead to either a strategy of punishment or a large-scale counteroffensive to reverse the initial successes of the opponent. Since a counteroffensive aimed at restoring the status quo ante (a likely U.S. objective in future conflicts) will tend to require far more U.S. force than a defensive operation, the lack of forward deployed forces will raise the cost of U.S. intervention and may tip the balance in favor of not intervening in some future conflicts.

The magnitude of the advantage conveyed by short warning attacks will depend in part on the speed with which the United States is prepared to respond to opposition actions. The U.S. players feared that the U.S. president might have to pause at the beginning of a conflict to build a consensus both within the United States and internationally; this pause may give opposition forces sufficient time to achieve their objectives unless U.S. allies within the region can effectively defend forward.

The feelings of the opposition players were essentially unanimous in that they would want to amplify the implications of short warning by forcing the United States to deploy into a hostile environment. In ODS, the United States deployed into secure ports and airfields and enjoyed the advantages of substantial host-nation support. In future wars, prospective opponents will have significant incentives to threaten U.S. entry into the theater. At the lower end, such a threat may imply that the United States must deploy security and area defensive forces (e.g., Patriot missiles) early and face the increased risk of significant losses early

¹⁸Some argue that the increasing capability of U.S. air power may now make it possible to deny enemy objectives without having to deploy U.S. ground forces. This issue is difficult to evaluate without first considering opposition responses to U.S. air power, as addressed below.

in the campaign. These changes could significantly lengthen the time required to put a complete defensive force into a theater, especially if the United States were also forced to operate through damaged facilities and to bring all the supplies required by U.S. forces.¹⁹ Moreover, the opposition players felt that airfields and port facilities were very high-density target areas that invited their attack.²⁰ At the high end of such threats, the United States may have to add several campaign phases in which it secures the required lines of communication and entry points before it can even deploy into the theater. If, for example, the Strait of Hormuz were closed by a combined arms threat of mines, land-based antiship missiles, aircraft, and submarines, it may take some time to neutralize these threats and even enter the Persian Gulf (let alone put substantial forces ashore).

Operational Concepts and Force Postures

The opposition players in our games felt that future U.S. opponents would have a clear sense for many of the key U.S. military strengths that they must be prepared to counter. Their counters require a combination of military operations and appropriate military force structure to support those operations. In almost every game we have played, the Red players have employed similar operational patterns:

- The focus of ground operations has been high mobility assault and seizure efforts. Most often, these efforts have employed infantry forces with high mobility (e.g., airborne, air assault, or amphibious capabilities) and good ability to engage opposing heavy forces through the use of light weapons such as a fiber-optic guided missile (FOG-M) or a sensor-fuzed weapon.²¹ Some armored forces have tended to be retained and improved on the margin, both to provide combined arms capabilities to opposition ground forces and to direct U.S. attention away from the opposition infantry forces.
- Special forces operations give the prospect for deep projection of power against high density, fixed targets (such as C³I nodes, ports, and airfields).
- Ballistic and cruise missiles are also key vehicles for attacking high-density enemy targets, especially when mated with improved conventional munitions or weapons of mass destruction.

¹⁹For example, U.S. forces tend to have significant demands for petroleum products that were provided by Saudi Arabia in ODS but that may not be available in an opposed deployment or even in other theater areas.

²⁰The United States might attempt to reduce U.S. vulnerability at theater entry points by dispersing such operations but doing so would further slow U.S. entry efforts.

²¹These technologies, developed by the United States, appear to be very lucrative targets for acquisition by prospective opponents. FOG-M development was never completed.

- To counter U.S. air forces, they have tended to employ air defense operations with improved surface-to-air missiles and target-denial operations using mobility, dispersal, and target hardening. Preparations for air operations have been limited because third-world air forces have tended to perform poorly.
- To counter U.S. naval forces, the focus has been on combined-arms, sea-denial efforts, including mines, antiship missiles, and other threats to interdict U.S. naval forces effectively or at least to deny sea control for some period of time.

Air Forces Are the Future U.S. Center of Gravity²²

In ODS, the U.S. and coalition air forces showed their tremendous power, including a combination of lethality and rapid deployability. Opposition players who sought to achieve objectives rapidly felt they had to be prepared to deal with U.S. air power, even if their objectives might be obtainable within a few days. This pattern makes U.S. air power the likely first focus of opposition attempts to deal with U.S. power projection. Section 4 develops the operational character of possible opposition attacks in more detail, and the appendix expands on this approach.

From a strategic perspective, few opposition teams in our games have been willing even to attempt to attack U.S. air forces in the United States (where the aircraft tend to be most vulnerable, but where opposition forces may not have effective attack means) because they anticipate that such attacks would solidify U.S. public opinion against the opposing power(s), and increase the likelihood and persistence of U.S. involvement in the regional conflict. We are less certain that such attacks will be precluded by opponents with different cultural norms, especially once the United States has pressed strategic attacks against their homelands.

Technologies Can Also Work Against the United States

To maintain an advantage in future battlefields, the United States has expended much effort to develop new military technologies. However, some of these same

²²The term "center of gravity" comes from von Clausewitz. One problem with the term is that it has a number of definitions. We have chosen to use it to mean the heavy point of combat or focus of combat power.

technologies, if obtained by U.S. opponents, could pose serious threats against U.S. military forces.

For example, Red players in our games examined various anti-armor weapons they might develop, ranging from sensor-fuzed weapons to the Army Tactical Missile System (ATACMS) to infantry weapons such as the FOG-M.²³ They believed that if they could acquire these technologies in sufficient numbers, they could neutralize the strengths of U.S. armored forces, including their mobility and ability to maneuver.²⁴ They recognized that such capabilities might force the United States to reconsider the Army force structure (now projected to consist primarily of heavy-armored and mechanized units) and Army doctrine and force employment concepts, although they hoped that the United States would be slow to recognize their new capabilities and not begin to adjust adequately until problems developed on the battlefield.

The Red players recognized that the Iraqi use of ballistic missiles in ODS showed how the possession of some weapon technologies by an opponent can force the United States to rethink its capabilities and operations. They viewed such impacts, however, as almost purely strategic and sought for weapons that would cause combined operational and strategic impacts. If it exists, the Russian Scud D could be such a weapon. Reportedly, it has a 45-meter circular error probable (CEP) (the radius of a circle within which half the missiles will land), a runway-penetration submunition warhead with a 125-meter radius of effects, and an anti-personnel submunition warhead with a 250-meter radius of effects.²⁵ Similarly, they wanted to acquire sophisticated, deep-water mines; even if they could scatter only a few of these mines throughout the waters within 500 or so miles of the theater, they believed that such weapons could cause a strategic disaster to U.S. forces or cause the United States to stand off for a protracted period while deep-water mine hunting proceeded.

As a general proposition, Red players sought to acquire weapons that were relatively simple to employ (e.g., cruise missiles as opposed to manned aircraft) and yet would challenge the United States with significantly increased lethality. The Red players anticipated slow or no U.S. reaction to such developments, and even if the United States responded to a more lethal battlefield by reducing force

²³ A fiber optic guided missile with both anti-armor and air-defense capabilities.

²⁴ While the Red players attempted to disperse these weapons to make them less vulnerable, they did not systematically examine the relative vulnerability of their projected forces compared with U.S. forces. That effort must still be pursued.

²⁵ These Scud parameters are described in *Jane's Strategic Weapon Systems*. Runway cratering would not be the only desired effect against airfields. Rather, such submunitions could also be effective in damaging unsheltered aircraft; maintenance facilities; petroleum, oil, lubricants, (POL) pipelines and storage; and crew facilities.

density, the players might achieve their objective of preventing the United States from bringing to bear a force of critical mass sufficient to rapidly defeat their forces.

Weapons of Mass Destruction²⁶

For many decades, U.S. strategic nuclear weapons were perceived as the ultimate deterrent force in the world, extending at least some degree of protection to any country coming under the U.S. nuclear "umbrella." However, the Red players in our games paid scant attention to U.S. strategic nuclear weapons; they did not believe that the United States would use such weapons in any of the conditions considered (including after their own nuclear use) and thus felt largely undeterred by them.²⁷ This issue clearly needs further study.

On the other hand, Red players did pay substantial attention to the weapons of mass destruction that they were credited with possessing.²⁸ Working from the perspective of conflict with the United States, they generally felt that these weapons would serve primarily as vehicles for regime survival to help deter foreign action that might directly threaten their regime. Since these countries tend to have autocratic regimes that may have somewhat fragile underpinnings, the players felt they needed powerful weapons to suggest the cost they are willing to impose against anyone attempting to overthrow them.²⁹ In turn, when the players assumed a Blue role, they were struck with how the U.S. doctrine of strategic attack, and the potential U.S. objective of overthrowing the opposition regime (supported by those who believe we should have continued our attacks

²⁶Some of RAND's work in this area include: Samuel Gardiner, "Playing With Nuclear Weapons," *RSAS Newsletter*, RAND, February 1993, and Daniel B. Fox, "Atoms for Peace," *Military Science and Modeling*, August 1993.

²⁷Prospective U.S. opponents may respond differently and feel deterred, at least in part, by U.S. nuclear weapons. The inability to systematically address this issue is a clear limitation of these games.

²⁸It is difficult to know when a foreign power will actually have nuclear weapons. Despite all the attention that has focused on the potential North Korean nuclear weapons program, the uncertainty is still significant. For example, DoD's *Early Bird*, March 3, p. 16, cited "The March 4 Stern magazine also quotes Russian intelligence reports as saying 56 kg of plutonium was smuggled to N. Korea from the former Soviet Union last year. Stern cited what it said was a previously secret Soviet KGB report from Feb. 1990 which said N. Korea had just assembled its first nuclear warhead at its Yongbon (sic) nuclear power station." In December, Secretary of Defense Aspin said that, "The range of uncertainty about the North Korean nuclear bomb includes the possibility that they might possess a single nuclear device, . . ." (Bill Gertz, "N. Korea May Have Nuclear Weapon, Aspin Says," *Washington Times*, December 13, 1993, p. 1). Several days later a report stated that, "North Korea possesses 'several' small nuclear bombs and the means of delivering them . . ." ("North Koreans Reported to Have 'Several' Nukes," *Washington Times*, December 20, 1993, p. 1).

²⁹While we have had some difficulty getting Red players to assume the cultural norms of the countries they represent, some players did note that the use of such weapons would be consistent with either a near final attempt to prevent regime overthrow or as revenge for the overthrow of the regime.

into Baghdad in ODS), would directly confront the "regime-survival" objective that opposing countries would likely have for weapons of mass destruction.

The Red players also contemplated using nuclear weapons (and perhaps other weapons of mass destruction) for intimidation. They proposed threatening their neighbors (either explicitly or in a veiled manner) with the use of nuclear weapons if a U.S. lodgment or U.S. basing were allowed; they also considered directly threatening a U.S. lodgment or other initial deployment with nuclear weapon use. Whether or not such threats would ever be carried out, they might deter or significantly slow U.S. action. In any case, they came to a recognition of the untenability of any large U.S. force concentrations or choke points. The Red players later found that as U.S. operations become more aggressive, the linkage between such threats and the imperative of regime survival became sufficiently close that the threats became real, and use became more likely. For example, in games where we have allowed U.S. objectives to include controlling a significant portion of the opposition territory, amphibious landings or other incursions into the enemy territory have been a regular target of at least chemical weapon use and often of nuclear weapon use (the opposition attempting to break the back of the U.S. threat and U.S. will before it can mature). Use of such weapons on their own territory for "defensive" purposes has consistently appeared to be justified by Red players.

"Blue" players faced with a nuclear threat have consistently attempted to neutralize that threat preemptively by conventional attack. They committed a major fraction of their strategic attack resources against nuclear weapons and other weapons of mass destruction.

The response of Blue players to nuclear weapon use has been intriguing. In most cases, the Blue players have concluded that a response with nuclear weapons would not inflict much more damage on the opponent than continued conventional operations (because of the lethality of U.S. conventional munitions); moreover, in the common case where opposition use of nuclear weapons is a desperation move, the Blue teams have not perceived the need to respond with nuclear weapons to achieve their operational objectives. Therefore, in an attempt to maintain U.S. coalitions and in trying to preserve the international consensus against the opponent that has used nuclear weapons, many Blue teams have not responded with nuclear weapon use.³⁰ In part, Blue teams have had difficulty in identifying appropriate targets for nuclear weapon use (often because of the

³⁰In games we supported in 1992, only two of 13 Blue teams responded with nuclear weapons to a one- or two-nuclear weapon attack by Red teams in a regional contingency. In 1993, seven of 13 Blue teams responded with a nuclear attack. A forthcoming article in *Military Science and Modeling* will describe our related observations in more detail.

conventional damage already done). Moreover, the fact that it might take several dozen tactical nuclear weapons to neutralize an opposing army division surprised many players. Some vocal minorities have urged a nuclear response to serve as a deterrent against other third-world nuclear powers or have been anxious to respond to the perceived outrage of the U.S. public; occasionally a nuclear response has occurred. Blue players who have experienced dealing with nuclear weapon use in recent games appear considerably more prone to respond with nuclear weapons when the problem is posed in a second game—an interesting learning pattern.

Some Blue players contemplating nuclear response feared that the U.S. public might react negatively to a U.S. nuclear response in the context of a limited war that the United States appears to be otherwise winning. Unfortunately, it is extremely difficult to predict how the U.S. public will react (and how their reaction will change over time), and Blue players worried about the effects that a nuclear response could have on coalition coherence. As a result, the "Blue" players tended to threaten a heavy nuclear response to further nuclear weapon use by the opponent and to increase the conventional campaign against opposition strategic targets (especially remaining nuclear weapons and C³I).

Finally, we should note that games may be a poor framework for addressing issues associated with weapons of mass destruction. Just as the media and public response to the use of Scud missiles in ODS far overwhelmed any expectations, so might use of "strategic" weapons of a future war, forcing the U.S. to take different actions. It is difficult to infuse game players with the emotionalism of threatened nuclear weapon use, or the carnage of actual nuclear weapon use, and properly capture the reactions that might occur in fact.

C³I Requirements and Implications

During the Cold War, the United States focused considerable effort on understanding the Soviet Union, its objectives, its technologies, its force structure, and its doctrine. Despite this effort, the United States occasionally experienced surprises, and more often had gaps in what was known. Still with what the United States knew, it was able to prepare for confrontation and was ready to fight if so required.

In the future, prospective opponents will be more diverse, and the United States must generally confront them with reduced intelligence resources because of budget constraints. As a result, at least some of the Blue players anticipated surprise and sought for a C³I system sufficiently robust to respond appropriately.

While the United States can anticipate some degree of surprise with regard to warning, the United States may also experience surprise with regard to opposition force structure, military technologies possessed, and operational characteristics. Such surprises could cause significant reversals in the conflict and undermine U.S. will. Many Blue players feared that the United States would not be prepared to adapt to such new conditions. For example, as opposition lethality was increasing, the Blue players felt uncomfortable adjusting to low density, nonlinear combat environments.

In general, the Blue players felt that the command/control system of the future battlefield must be highly robust and adaptive. If the United States is to fight at low densities in nonlinear combat, it must be prepared for significant devolution of authority to pursue what will likely be very complex conditions when viewed in the aggregate. Also, the United States must be prepared to somehow integrate the complex conditions and apply supporting fires and other assistance in a meaningful manner. Poor C³ may mean that fratricide increases to an intolerable level or that the United States fights the enemy of the last battle when he has evolved and is now fighting differently.

Conclusions

As we think about the future of warfare, it is important to remember the dynamics involved: "As in any game from football to chess, each contestant is possessed of an independent will and can only be controlled by the other to a very limited extent. With each side seeking to achieve his objectives while preventing the other from doing the same, war consists in large part of an interplay of double-crosses. The underlying logic of war is, therefore, not linear but paradoxical. The same action will not always lead to the same result. The opposite, indeed, is closer to the truth. Given an opponent capable of learning, a very real danger exists that an action will not succeed twice because it has succeeded once."³¹ Sun Tzu also recognized the folly of trying to repeat previous successes when he stated in *The Art of War*: "Do not repeat tactics that have gained you one victory, but let your methods be regulated by the infinite variety of circumstances."

Some of our views of the future suggest that despite its military power, the United States may face severe challenges in future major regional contingencies.

³¹Martin van Creveld, *Technology and War: From 2000 B.C. to the Present*, (New York: The Free Press, 1989), p. 319. The passages quoted and related insights were originally published in Samuel Gardiner, "It Isn't Clear Ahead, But I Think I Can See the Edges of the Road: The Character of Future Warfare," *RSAS Newsletter*, RAND, November 1992.

If the reactions of our Red players are reliable, the old deterrent effect of strategic nuclear weapons appears to have little effect on prospective regional adversaries. Instead, they may perceive that they can achieve their objectives by proper exercise of operational initiative, by making the cost of U.S. intervention high, and by otherwise appropriately setting the political context and parrying U.S. military strengths for at least some period of time. If so, we may see a repeat of the conditions surrounding World War I, in which to wait was to fail.³² At very least, the context for deterrence has changed, and the United States must seriously reconsider how it may or may not play a role in future major regional contingencies.

War appears to be evolving and perhaps evolving quite rapidly. The battlefield of the future could well be quite different from the battlefield experienced with ODS³³ or a battlefield that we might expect to see today. Military analysis must begin to comprehend these potential changes and to adjust our models so that we can properly assess future military capabilities.

³²See Barbara W. Tuchman, *The Guns of August*, Macmillan Publishing, New York, NY, 1962.

³³Operation Desert Storm was uniquely favorable to the United States, including issues such as a national command authority willing to approve the use of overwhelming force, the United States at the absolute top of the Cold-War build up, the United States with significant technological advantages in every combat arm, no major distractions of U.S. attention, plenty of time for the United States to prepare, allies willing to defray U.S. costs, a highly developed infrastructure that was well supported by theater allies, the initiative entirely with the coalition (after Iraq seized Kuwait), and flat and light soil terrain (for the most part). Moreover, we faced a nearly friendless opponent, whose forces proved to be highly unbalanced and whose personnel proved to be dispirited and demoralized even before the fighting began (although this was not common knowledge), and who pursued a passive and entirely conventional operation. We can also be sure that, although Iraq had a number of chemical weapons, it had no nuclear warheads.

4. Structuring Our Thinking on the Future of War

Much of U.S. thinking about the future of warfare seems fixed on developing U.S. capabilities and how they will allow the United States to be even more decisive in future conflicts than it was in the Persian Gulf War. Many of the new technologies being pursued are impressive and will give the United States revolutionary capabilities in areas such as: global surveillance and communications, precision strike, air superiority and defense, sea control and undersea superiority, advanced land combat, and nonlethal weapons.¹ In recognition of these and past U.S. advances, prospective U.S. opponents appear to be adjusting their approaches to warfare in ways that the United States will likely find challenging.

Section 3 describes some of our war gaming observations on the future of warfare. We have analyzed these in some detail and extended them into an initial structure for thinking about the future of warfare. This section presents our proposed structure, oriented around four key observations:

- Warfare will be characterized by uncertainty and variability.
- Adversaries will seek new patterns of warfare to effectively oppose the United States.
- Asymmetrical battles will characterize war.
- Weapons of mass destruction cast a shadow over almost all future contingencies.

What Kinds of Contingencies Have Been Considered?

It is difficult not to allow thinking about future contingencies to be largely conditioned by the experience of Operation Desert Storm. The discrete nature of the deployment and campaign, in terms both of time and space, as well as its highly successful outcome, make it the natural template to apply to questions

¹The first five of these areas are five of the seven science and technology thrusts introduced in Director of Defense Research and Engineering, *Defense Science and Technology Strategy*, July 1992.

relating to the future engagement of U.S. forces, be they issues of strategy and doctrine, or of force size and structure.

Future contingencies will not be a rerun of the Persian Gulf campaign. In part, this conclusion derives from straightforward analysis of a range of currently foreseeable contingencies in which the United States might conceivably become militarily involved. The range of possibilities we have considered is suggested in Figure 4.1. We divide these into three categories: (1) MRCs in which the United States would likely sense a vital interest (with the Korean and Persian Gulf cases indented to show their primacy in current defense planning), (2) other MRCs in which the United States would more likely play a peace-enforcing role, and (3) lesser regional contingencies (LRCs) in which the United States may also play a peace-enforcing role.²

Warfare Will Be Characterized by Uncertainty and Variability

Examination of the potential contingencies in Figure 4.1 suggests that future threats are highly uncertain. The uncertainty embraces the identity of the opponent, his objectives and strategy, the qualities of the technologies available to him, his force structure, and the skill with which he will apply his forces.³ By comparison, the historical Soviet threat was relatively certain in many dimensions and faced much more moderate uncertainties, primarily in areas such as actual weapon capabilities and how troops would really perform. While much of historical defense planning and analysis focused on "expected" conditions, the recent course of contingencies suggests that ignoring what often will be vast uncertainties is a serious peril.

Many of these factors can be expected to vary enormously from possible theater to possible theater, along with other variables such as weather, terrain, and infrastructure; the degree of possible allied involvement on either side of the conflict; and the coherence and motivation of the adversary's forces. These factors define the warfare environment that we would experience in a given contingency. To better clarify the expected kinds of differences, Table 4.1 contrasts conditions in the historical Central European environment, on which most models are based, and the Korean theater.

²We have done some work on characterizing the different kinds of MRCs and LRCs in which the United States might become involved in the future. This work is ongoing.

³This is not to say that key aspects of these contingencies cannot be foreseen. For example, the two MRCs of principal interest are still Korea and the Persian Gulf, though even in those areas, some potential exists for variations in such fundamental issues as the opponents we would face and the allies who would support us.

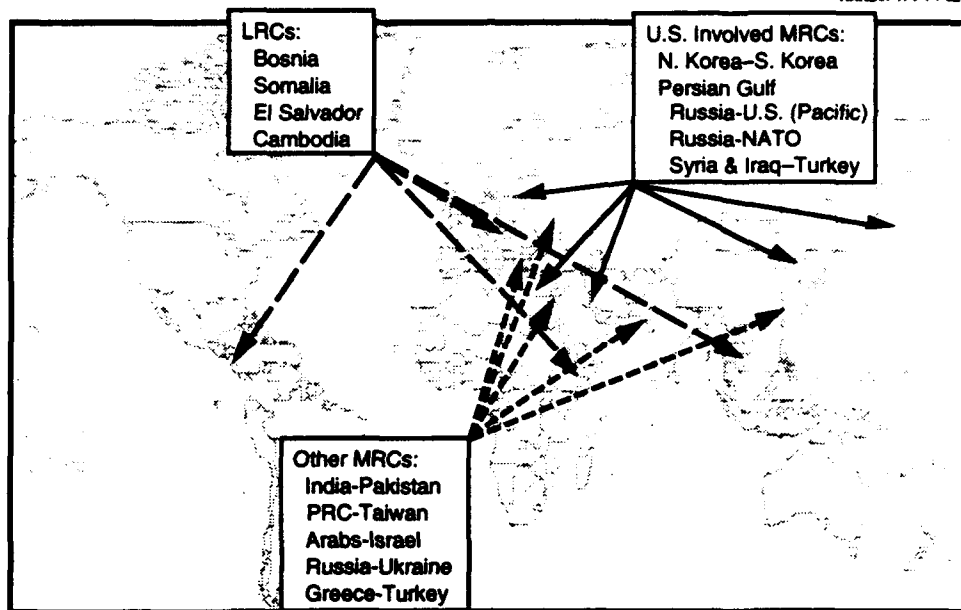


Figure 4.1—Classifying Future Contingencies

Historically, it was argued that Soviet doctrine and weapons pervaded almost any adversary the United States might face; therefore, U.S. defense thinking could focus on Soviet style and capabilities as those of the adversary. Such an approach no longer appears appropriate; instead, defense planners and analysts must be prepared to explicitly address differences in warfare environment among contingencies. We believe that the proper approach for doing so is to create a new class of “strategic and operational variables” that would more systematically define how various contingencies might differ from each other and also help identify the kinds of uncertainties faced in any given theater. These variables would likely be similar to the “Major Issues” column in Table 4.1,⁴ although clearly many other issues would need to be identified. Such variables should be of value in defense planning, training, and analysis; at the very least, they would provide a framework for thinking about the implications of alternative contingencies. Section 5 suggests an approach to developing such strategic and operational variables.

⁴A more thorough discussion of strategic and operational variables is found in, Bruce W. Bennett, “Flexible Combat Modeling,” *Simulation & Gaming*, June 1993, pp. 213-219 (also available as a RAND reprint, RP-220).

Table 4.1
Differences in Warfare Environment (an example)

| Major Issue (Example) | Historical Central Europe | Korean Theater |
|---|---|--|
| Context of Conflict | Adversary aggression | Adversary aggression or adversary civil war or ally initiative? |
| Objectives (U.S.) | Survival and freedom of NATO countries | Aid regional ally |
| Strategy (Adversary) | Defeat U.S./NATO forces in the field (selectively defeat weak partners) | Deter U.S./Japan involvement by creating "strategic events" |
| Operations (Offensive ground concept) | Penetration and envelopment of defending forces to destroy them; secure terrain objectives | Suppression and rapid penetration of defending units to secure terrain objectives |
| (Offensive air attack concept) | Use offensive counterair to suppress NATO air forces; establish local air control where possible | Suppress Korean air forces with special operations forces and missiles; threaten Seoul and support ground forces when possible; use ambush tactics defensively |
| (Chemical use) | Low chance, moderate preparations | High chance, low preparations |
| Resources (Assault forces) | Heavy forces with artillery support | Infantry with artillery and special operations forces support |
| Performance (Adversary's training) | Not as good as NATO in air or ground training | Highly inferior in air training, although tactics appropriate; superior to South Korea in ground training? |
| Allied Cooperation (Defensive alliance) | Large group of allies who clearly perceive a mutual threat | ROK firm, United States likely firm, other regional actors may delay in participating |
| Other factors (Ability of terrain to support armor) | Good—extensive road network and many good off-road options | Poor—mountains channel terrain, few roads, rice paddies deny most off- road options except when ground freezes |

New Patterns of Warfare

The conclusion that the next MRC is unlikely to resemble the Persian Gulf War is reinforced by the fact that, for whoever next decides to embark on behavior that could lead to conflict with the United States (either in terms of our vital interests or by threatening the peace), avoidance of any repeat of the Persian Gulf War scenario is likely to be a prime objective. The Persian Gulf War was the paradigm of what U.S. forces—as currently equipped, trained, and structured—do best. It provided the perfect showcase for the U.S. ability to bring to bear overwhelming conventional power in a coordinated, combined-arms fashion, with a precision enabled by advanced guidance technologies and world-beating surveillance and target-acquisition capabilities. It was the ultimate demonstration of the doctrine of overwhelming force in action and of the invincibility of U.S. power in a conflict of this type.

It follows that the next U.S. adversary will do whatever he can to avoid a conflict of the Persian Gulf type. He will no more seek to confront U.S. power on U.S. terms than David would have gone out against Goliath with a sword and shield. His prime aim will be to ensure that U.S. conventional forces cannot be brought decisively to bear. He will be acutely aware both of U.S. strengths and that the preferred U.S. pattern of warfare would involve several weeks of unopposed deployment, followed by the establishment of operational dominance (via air superiority, sea control, and attack of strategic targets), setting the scene for counteroffensive and decisive-war termination. Figure 4.2 illustrates this preferred U.S. pattern of warfare.⁵ He will realize that the pattern for the successful application of U.S. force requires time, cooperative allies in the region, and an enemy willing to present and identify himself. The intelligent adversary will seek to deny these to the United States and should be able to do so because normally he will have the initiative. He will be aware of the possibilities open to him to counter U.S. capabilities in asymmetrical fashion at the operational level (we discuss this topic further below), but he will realize that *his most effective responses will be at the strategic level*. The adversary will likely adopt a strategy to deter U.S. will to enter the conflict, to discontinue U.S. intervention if it occurs, and to ultimately wear out U.S. resolve and interest.

⁵C-day is the day in a crisis when U.S. force deployments begin into a theater, and D-Day is the day when combat begins in a theater. The terms used for phases herein are generally derived from Les Aspin, *The Bottom-Up Review: Forces For a New Era*, Department of Defense, September 1993 and an accompanying briefing on the "Bottom-Up Review," September 1993.

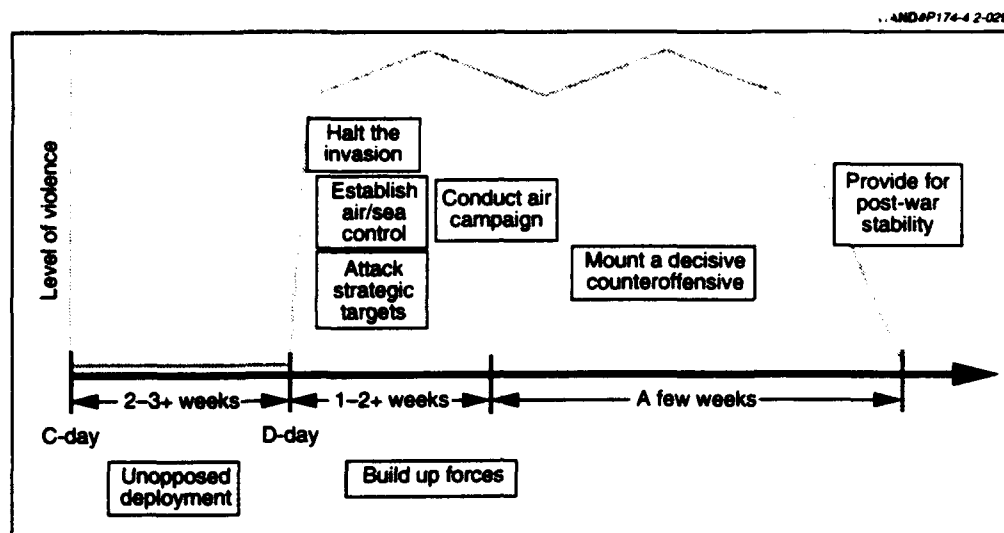


Figure 4.2—U.S. Assumed Pattern of Warfare

In this context, the range of contingencies shown in Figure 4.1 has both many variations and some consistencies. For example, consider the potential military approaches that each side might employ, where some options include:⁶

- Destroying or neutralizing the opposition army (along the lines recommended by Clausewitz), which could apply for U.S. actions when U.S. interests are high and the opponent has significant but attackable forces (e.g., Operational Desert Storm). Only a few MRCs are likely to meet the requirements of vital interests for such a U.S. commitment (e.g., the Persian Gulf and Korea).
- Seizing complete control of the opposing country, when its forces are small and easily overcome (e.g., Grenada or Panama). Even small local forces may be difficult to overcome if they assume guerrilla tactics, and so this option is not likely to be often available to the United States.
- Attacking the opposition strategy (as recommended by Sun Tzu) when the opposition's forces are either superior or not very vulnerable and/or his national interests are low (e.g., U.S. participation in Bosnia or Somalia). This

⁶See Sam Gardiner, "Playing With Mush: Gaming Lesser Contingencies," *Military Science & Modeling*, RAND, November 1993. Another military approach would be to punish the opposing country, perhaps through strategic attacks. While such an approach seems to have worked in the context of crisis coercion (e.g., the attack a few years ago against Libya), it is less clear that such an approach would stop, let alone reverse, the hostile actions of an aggressor (indeed, the strategic bombing of Operation Desert Storm apparently did not have such an effect). We have therefore not yet pursued this approach in any detail.

approach seeks "strategic events" that will cause the opponent to change strategy.

Because of U.S. military strength, most U.S. opponents will find the third kind of military approach about the only available alternative in opposing the United States, and thus the United States normally will find itself defending against strategic events. The essence of such strategic events derives from the fact that since U.S. survival is not at stake in any of these contingencies, so a U.S. decision to intervene will be a trade-off between the degree to which U.S. interests are served by intervention versus the costs that must be expended to achieve these interests. Strategic events will thus be aimed at causing a U.S. reappraisal of intervention in terms of the balance between the benefits and costs. In turn, the United States will also likely attack the opposition strategy by seeking strategic events.

A major change that has occurred in this area is the apparent U.S. concern for casualty minimization.⁷ Operation Desert Storm established new casualty expectations, relating both to U.S. losses and losses we might cause:

- Casualties will be low, even in MRCs (hundreds, as opposed to tens of thousands).
- Casualty levels will be manageable by changing operational approach or other factors.
- While some events may occur with relatively large losses (such as the results of the Scud attack on Dhahran), the casualties in such cases are still in the tens and not in the hundreds or more.
- While we may not be able to minimize casualties to opposing military forces, our precision weapons should allow us to minimize casualties to civilian populations in opposing countries.

U.S. casualties thus become a major focus for the opposition in creating strategic events; the U.S. will to participate in a nonvital conflict may be seriously affected if casualties do not conform to these expectations. Yet U.S. casualties could be significantly higher in future contingencies because of enhanced weapon lethality (that some prospective opponents are acquiring), increased requirements for infantry (as opposed to mechanized) operations, nonlinear battlefields and operations against the U.S. rear areas, and the potential for the use of weapons of mass destruction.

⁷See the discussion of this issue accompanying Figure 1 in Daniel Fox and Bruce Bennett, "The Future Military Environment and Military Modeling," *RSAS Newsletter*, RAND, November 1992.

Against this background, our analysis has suggested a range of ways in which the adversary who foresees or becomes engaged in conflict with the United States could (and likely will) try to improve his chances of success. It is convenient to consider these methods under three headings:

- By manipulating the strategic context
- By manipulating the strategic environment of the military campaign
- By manipulating the operational environment of the military campaign.

The adversary will be able to mold these contingencies because he will have the initiative in the conflict, at least at first.

Opponent Manipulation of the Strategic Context

For any regional power contemplating an aggression that risks a U.S. response, the first lesson from Saddam's debacle must be to take pains with the political stage-management. Events must be handled so as to provide the United States with the best possible excuses and reasons not to intervene and strategic events that challenge any decision to intervene. The strategic "target" of adversary action is the U.S. will to intervene. While U.S. opponents may have some difficulty achieving these effects, some of the political strategies they may attempt to employ are

- The situation should be presented as one in which U.S. intervention is demanded neither by U.S. national interest nor by considerations of principle. The broadcast of assurances are necessary—those relating to the well-being of U.S. nationals or the continuing availability of important raw materials (such as oil). Also, an effort (possibly over many months in advance) will be required to convince U.S. public opinion that the victim of the aggression does not deserve the spilling of any U.S. blood in his defense. This effect may be achieved if the target country's government is perceived as totalitarian, oppressive, and/or is in a state of anarchy (such that invasion can be represented as a necessary restoration of law and order).⁸
- Bearing in mind the time required by the United States to deploy into any theater, the aggressor may be well advised to pursue a short war. He would

⁸Most U.S. adversaries cannot directly cause such perceptions in the United States, but they may be able to contribute to them. For example, North Korea might at some point return to efforts to destabilize the South Korean government and might incite riots or other problems in South Korea that could cause a harsh reaction by the South Korean government, leading to an increased U.S. perception of both anarchy and oppression in South Korea.

create the desired end state on the ground before the United States could respond. Probably a strategy of surprise will be required that will give the United States minimal response time,⁹ even at the expense of less-than-perfect preparedness on the aggressor's own part and limiting objectives to those that can be rapidly attained (e.g., the North Koreans seeking to move the DMZ down toward the Han River and the transformation of Seoul into an "international city," as opposed to capturing the whole Korean peninsula). As Hitler demonstrated in the 1930s, successful attainment of a series of limited objectives in due course can add up to the attainment of some very large ones. If a new situation favorable to the aggressor can be rapidly stabilized, U.S. intervention may be not only militarily more difficult but also politically more invidious: "restarting the bloodshed."

- Ideally, aggression will be timed to take place when the United States is distracted by some significant crisis elsewhere. Discussion in the United States of the need for the capability to fight and win two "nearly simultaneous" MRCs has underlined the extent to which, in the post Cold-War era, such a challenge could stretch the United States. It will, therefore, make sense for the regional aggressor, even if he cannot positively orchestrate a significant diversion elsewhere,¹⁰ at least to exploit one if it occurs.

⁹For example, in the Persian Gulf War, the U.S. military response did not occur until after Kuwait had been captured. Historically, many U.S. analysts assumed longer U.S. preparation times, in part to allow U.S. ground forces to deploy and participate in the conflict. Moreover, much of the military analysis community argued against short response times because of: (1) the need for opponents to mobilize and prepare to have maximum military capability in a conflict and (2) the quality of U.S. intelligence and warning capabilities to perceive such preparations. The United States needs not only the ability to perceive military preparations but also a more general understanding of opposition intent (the problem faced by both the United States in the Persian Gulf War and the Soviet Union in 1940) and the will to respond given the various uncertainties. One may also argue that with limited objectives, an opponent may be willing to forego some preparations (and thus give at best ambiguous warning) if by so doing he will delay the U.S. response. Such short response times appear to have become more the base assumption in recent Defense Department analysis. See, for example, Les Aspin, *The Bottom-Up Review: Forces For A New Era*, Department of Defense, September 1, 1993, especially pp. 5-6.

¹⁰Many prospective U.S. opponents are increasingly isolated from the rest of the world, and share many interests; for example, we already know that several of these states have shared ballistic missiles and ballistic missile technology and believe that they are sharing nuclear technology: "Western intelligence sources report . . . a series of secret deals between the Stalinists of North Korea and the ayatollahs of Iran. Under the arrangement, Tehran is giving the Pyongyang government \$500 million to help it develop a ballistic missile system that could deliver nuclear and chemical warheads to targets in Japan. In return, North Korea has agreed to sell an unspecified number of nuclear bombs to the Iranians and to provide them with designs for nuclear-weapons-reprocessing plants. According to one estimate, by 1995 the North Koreans could possess sufficient weapons-grade plutonium to manufacture as many as seven bombs." "Washington Whispers," *U.S. News and World Report*, March 29, 1993, p. 18. Such joint efforts, if true, might not lead to true alliances, but they could lead to limited coordination of efforts given the mutual benefits that would likely accrue from diluting the U.S. response.

The interesting question is, "What does it take to deter U.S. intervention?" Historically, our analyses of deterrence have focused on deterring opponent (especially Soviet) action; in the future, we need to be able to address deterrence of the United States.

Manipulating the Strategic Environment

In future conflicts, the United States will want a quick, decisive campaign, with relatively few casualties. The adversary must demonstrate that this U.S. game plan will not be achievable. Some skill in the modulation of the level of violence will be needed. A strategic event involving some spectacularly heavy loss of U.S. forces at the outset of the conflict may lead to a U.S. withdrawal, similar to that following the truck-bomb attack on the U.S. Marine barracks in Beirut several years ago or a firm U.S. commitment similar to that following the Japanese attack on Pearl Harbor. Creating the proper kind of strategic event suggests that the smart adversary may follow a progressive approach, along the following lines:

- The immediate imperative is simply to demonstrate that "blood will flow" in consequence of U.S. intervention; this approach will be particularly effective if the initial aggression has been carried out with relatively high casualties. For this purpose, losses by the regional participants, including the aggressor, will be as good or better than U.S. losses and perhaps even more effective if the United States causes some of the losses. Consider for example the shock felt in Britain at the sinking of the Argentinean cruiser *Belgrano*, with heavy loss of life, in the opening stages of the Falklands conflict. Civilian casualties will be particularly effective; perhaps the United States can be manipulated into shooting down a commercial airliner. Civilian casualties can also be maximized during the anticipated U.S. strategic air campaign by careful collocation of targets: Every bunker should be beneath a Sheraton, every SAM battery on the roof of a mosque, and every chemical warfare factory beside an elementary school.¹¹ The probability of creating a strategic event can be maximized by granting full access to the U.S. and international media. Even if U.S. will is not significantly shaken, the support of any U.S. coalition will surely be complicated.
- The United States, too, must suffer casualties. In the early stages before the United States is fully committed, it is better for the opponent to inflict

¹¹A major uncertainty is the extent to which U.S. public opinion and perhaps more importantly international public opinion will allow collateral damage. The experiences of both the Persian Gulf War and Somalia suggest that some collateral damage will be tolerated, but large numbers (hundreds?) of particularly innocent casualties may become a heavy burden.

casualties by "indirect" means, avoiding an incontrovertible "signature" and, therefore, not providing a clear justification, or target, for retaliation.

Examples might be the use of naval mines, of third party terrorist, and/or of special forces attack. As in the case of the attack on the U.S. Marines in Beirut noted above, the lack of an obvious target against which to retaliate may deepen the sense of unease in the United States about just what U.S. forces are getting into, more than it enflames U.S. national desire for revenge.

- If, despite such tactics, a significant U.S. intervention proceeds, the adversary may need to create a strategic event with sufficient military or psychological impact to stop the intervention in its tracks and cause the United States (and/or its partners) to reassess the wisdom of their chosen course. A really devastating series of terrorist attacks, perhaps even on the United States homeland, might achieve this purpose. The sinking of a capital ship would be such a strategic event, if it could be done. An appropriate strategic event might be caused by the use of nuclear, biological, or chemical weapons against U.S. or coalition forces in the field; concentrations of relatively less well protected coalition forces in rear areas; the homelands of regional coalition partners; or even, as ballistic and cruise missile technologies proliferate, against the U.S. homeland itself. Any such strategic event would clearly be high risk—it might very well cause a "Pearl Harbor" reaction, leading to an ultimate "Hiroshima" and drive for unconditional surrender. But at the very least it would achieve an "operational event" involving a significant time-out in a campaign that was developing badly.

Management of the Campaign: The Operational Environment

At the operational level, opponents may be able to manipulate a number of aspects of future warfare. For example:

- If the campaign develops to the point where ground engagements occur, the adversary will be guided by the need to maximize U.S. casualties. He will aim for a nonlinear battlefield,¹² where he has close contact with U.S. forces, making the targeting of his forces more difficult and, in an attempt to use U.S. lethality against U.S. forces, U.S. fratricide more likely.

¹² Analysis has traditionally conceived of battles being fought along relatively neat lines such as the "forward edge of the battle area." In a nonlinear battlefield, the forces of each side are much more intermixed, either because that condition is sought by one or more participant or because the condition simply develops. See Sam Gardiner, "The Lineage of the Nonlinear Battle," RSAS Newsletter, RAND, January 1992.

- He will likely prefer fighting in urban terrain. To the extent that concerns about collateral casualties becomes serious in this environment, the United States may have to limit its use of advanced munitions (especially area effects weapons, for fear of collateral damage), "leveling the playing field" to the point where the United States may not be able to accept the resulting casualty exchange ratios.
- He will be conscious of the "seams" in the C³ of coalition forces; he may even seek to create conditions in which coalition forces erroneously attack each other (or appear to have done so).
- More generally, he will seek infantry as opposed to armored engagements (in part by seeking enclosed terrain), engagements that reduce the advantages of U.S. armor and expose U.S. personnel more to attrition.
- If the adversary feels he cannot win the conventional battle, the adversary can be expected to resort to classical guerrilla tactics. He will deny battle to U.S. forces when he does not possess an advantage and press battle selectively when he feels an advantage can be gained. In Somalia, General Aidid has shown himself to be the most recent exponent of this approach.

In essence, the opponent would attempt to create a battlefield environment more like Vietnam than the Persian Gulf. He would be seeking "operational events" in which U.S. failures to achieve objectives or the costs paid by the United States led to a change in the operational approach. For example, some limitations the United States may have to face include:

- The abandonment of air bases, ports, or other facilities struck with persistent chemical weapons, since decontamination uncertainties may imply too great a risk against the requirement to minimize casualties.
- The abandonment of parts of the operating environment because of opposition threats. For example, U.S. air forces may be precluded from operating below 10,000 feet because of air defense artillery and shoulder-fired SAM threats (though this floor may be pushed to 15,000 feet or more as more advanced air defense weapons are obtained).
- The abandonment of many kinds of operations. For example, the United States may conclude that an amphibious assault against enemy terrain may be too risky if the opposition likely possesses nuclear weapons.¹³

¹³As discussed in Section 3, in our war gaming experience, amphibious assaults against enemy territory (e.g., against Pyongyang or Wonsan in Korea) are often staged as part of a U.S. coalition counteroffensive, in which a military threat is being placed against the survival of the opposition regime. In such circumstances, a nuclear response seems quite possible, especially since that

From the opposition perspective, it would clearly be ideal if it could create operational events that also became strategic events. Thus, if North Korea could induce the United States to abandon its air bases in South Korea, and by so doing cause a crisis of U.S. will for intervention in a Korean War, the operational development will have well served overall North Korean objectives. The opposition must still recognize, though, that the outcome of such a strategic event could be a renewed and expanded U.S. intervention (especially if many Americans are killed by chemical weapons or a nuclear attack).

Asymmetrical Battles Will Characterize War

Recent military discussions have described several alternative future battlefields. Russian writings have focused on a high-tech, symmetrical development along the lines of the U.S. achievements in Operation Desert Storm and is seeking further developments of military technologies. But few if any future U.S. opponents will likely be able to respond symmetrically to the United States; therefore, we anticipate that future battlefields will develop asymmetrically.¹⁴ The extremes in asymmetry may occur if a high-tech U.S. force is countered by a guerrilla force, practicing irregular warfare. These alternatives have substantially different implications from each other and require an analytic approach that allows all the alternatives to be considered.

The High-Tech, Regular Combat Battlefield

Recent Russian writings on the future of war focus on the developing high-tech, regular combat battlefield.¹⁵ They believe that, "Future war will be dominated by precision weaponry, 'information support' (i.e., reconnaissance and C³) and electronic warfare (EW), the three being integrated with synergistic effect into a combat system which will again fundamentally change the nature of warfare."¹⁶ "Long-range battle is not merely enjoying an increasing role but will become the dominant, and often an independent, form of combat in future war. Employing EW, fixed and rotary wing aviation, cruise and ballistic missiles and long range tube and rocket artillery with ACMs, key elements of the enemy's tactical and

response can be executed on the opponent's own territory or in its coastal waters (which is very different from striking coalition territory), and thus complicates likely U.S. responses

¹⁴The importance of the asymmetrical battle first came to our attention in the work done by LtGen. Phil Shutler, USMC (Ret). General Shutler applied the framework of asymmetrical battle to describe the success of U.S. operations in the Pacific during World War II. He uses this idea of asymmetrical battle in a course he teaches at the National Defense University.

¹⁵See, for example, C.J. Dick, *Russian Views on Future War*, Conflict Studies Research Centre, The Royal Military Academy Sandhurst, June 1993.

¹⁶*Ibid.*, p. 2.

operational groupings will be engaged throughout the depth of their deployment very soon after their detection by multifarious air and space-based reconnaissance means. Effective strikes may be exploited rapidly by air and air-ground echelons—air assault, forward, raiding and enveloping detachments—to defeat or destroy the crippled and disrupted enemy and gain a tempo. What used to be thought of as the 'main forces,' the bulk of the tank and mechanized troops, will essentially be reduced to the role of exploitation elements (as, indeed, they were regarded in the nuclear period). For safety, they may be held far from contact with the enemy 'main forces' during the decisive 'electronic-fire engagement,' and may, even on committal, engage in close combat for far briefer periods than hitherto."¹⁷

Maneuver takes on a new role at two levels. Tactically, "... units move frequently to increase their chances of ducking out from under an upcoming strike."¹⁸ Operationally, the combination of air power (including helicopters), missiles, and long-range raiding and vertical envelopment has fundamentally changed the character of battles. For example, "... raiding forces in the enemy's depth may not so much aid and support the advance of the main forces as be their cutting edge. After all, the main combat power of either side will reside in its long range weaponry and associated 'information support' and command and control, which are deployed in the depth, and the destruction or disruption of these will confer a major, perhaps decisive advantage to the more successful side."¹⁹

Defensively, "... even if the defender were able to deploy huge numbers, it would not be possible to create an insurmountable defence. No matter how well prepared in the engineering sense, no matter how dense or deep, precision and ACM strikes will blast breaches as assuredly as their nuclear predecessors (albeit without the latter's collateral damage and contamination which hindered exploitation). Moreover, vertical envelopment will also be used to erode the cohesion of the defence. Rather, operational defence will have to deploy half or even more of available forces in the second echelon and rely on maneuver for success. After prolonged debate, the Russian theorists are now coming to accept that only manoeuvre defence is viable on the future battlefield. This will comprise firstly the manoeuvre of fire, obstacles (remote mining) and electronic strikes to inflict attrition and disruption on the attacker while he is approaching the forward edge. When penetration—accepted as inevitable—occurs, the defender will conduct delaying actions, withdrawal to depth positions or

¹⁷Ibid., p. 6.

¹⁸Ibid., p. 8.

¹⁹Ibid., pp. 7-8.

counter-penetration where the attacker is strong, and counter-thrusts where he is vulnerable. The aim will be to affect such a change in the correlation of forces that the defender can seize the initiative and, exploiting successful counter-strikes, go onto the counter-offensive."²⁰

A Reactive Approach

The author of *Russian Views on Future War* concludes his description with some interesting comments: "It is, however, unlikely to say the least that Russia will be able to make the technological or the economic progress in the foreseeable future that will be required to keep the country in the first rank of powers able to conduct high-tech, high-intensity conflict. Once again, as in the twenties and thirties, theory is marching well ahead of practical ability. More disturbing still for Russia, however, is the fact that her military thinkers seem to be devoting their talents to the study of the sort of war Russia is perhaps least likely, as well as least able, to fight. Little work appears to be done on the mid and, particularly, low intensity conflict that is certain to trouble the country."²¹ If the Russians are unlikely to be able to pursue the high-tech approach, we can expect few others will have that ability.²²

An alternative for addressing U.S. military power can be referred to as the "reactive" approach. The foregoing analysis of how a smart adversary may be expected to try to manage U.S. responses to his aggression was based on the straightforward assumption that he will seek to avoid U.S. strengths and exploit U.S. weaknesses. Similar considerations can be expected to inform his approach to military planning. For example, the adversary will likely avoid air combat with the United States (a symmetrical response) and instead seek to destroy U.S. aircraft on the ground or apply passive defenses to his targets to make them difficult to destroy using aircraft. His exploitation of U.S. weaknesses will create asymmetrical battles. A similar approach may be expected to exert some influence on the force structure he adopts and the military technologies he pursues, over time.

This argument should not be overstated: no regional power will be guided in these matters solely or even primarily by the prospect of conflict with the United

²⁰Ibid., p. 7.

²¹Ibid., p. 15.

²²The Swedish approach to the high-technology battlefield is an interesting complement and counterpoint, as described in Sam Gardiner, "High Tech Commandos: The Swedish Version of the Fragmented Battlefield," *Military Science & Modeling*, August 1993.

States.²³ Regional powers are influenced in their military decisions primarily by regional considerations. Operation Desert Storm may have demonstrated that a conventional air force will be of little use to a regional power against the United States, but it does not follow that a country such as Iran will not wish to maintain such an air force to assist it in dealing with its regional opponents. Also it should not be assumed that if a regional power chooses to pursue NBC weapons or ballistic or cruise missile technology that it will be doing so primarily to confront the United States; such proliferation will likely continue to be fueled, as in the past, by regional rivalries and ambitions and by the imperative of regime survival.

Countering U.S. Strengths

Nevertheless, and subject to that caveat, aggressive regional powers can be expected to concentrate on developing capabilities that advanced military powers will find hard to deal with. They should not be expected to do so by matching U.S. capabilities, in large part because many U.S. capabilities are highly advanced (they cannot be matched in the short-term) and are also cultural in many cases. For example, U.S. air power is as much as anything a function of issues such as training approaches, the susceptibility of personnel to training, the willingness and ability to delegate authority and support independent operations by subordinates, and the ability to assimilate a complex situation rapidly and determine an appropriate course of action. Thus, even if U.S. opponents acquired Flanker or Fulcrum aircraft, they would not likely pose a major air threat against U.S. air forces (at least in the short-term).

However, other ways exist to counter U.S. strengths.²⁴ Opponents can often find a wide range of counters, many of which do not require the skill, training, or other U.S.-unique attributes behind U.S. strengths and, therefore, put these counters within the reach of prospective U.S. opponents. Opposition acquisition of key weapon technologies, and the fielding of appropriate weapon systems, could significantly impact both opposition and U.S. doctrine and, by implication, also affect U.S. force structure. For example, how would the U.S. respond to an opponent with a large cruise missile force equipped with sensor-fuzed weapons,

²³However, countries like North Korea who face established U.S. alliances or declared interests may be strongly influenced by their likely requirement to deal with the United States if they attack a neighbor.

²⁴The counter capability logic is developed in more detail in Sam Gardiner, "It Isn't Clear Ahead, But I Think I Can See the Edges of the Road: The Character of Future Warfare," *RSAS Newsletter*, RAND, November 1992; Bruce Bennett, "A Counter-Capability Framework for Evaluating Military Capabilities," *RSAS Newsletter*, RAND, February 1993; and Dan B. Fox, "Counter-Capability Air Campaigns," *RSAS Newsletter*, RAND, February 1993.

designed to defeat current armored/mechanized forces and doctrine?²⁵ Because these counters are not symmetrical with U.S. capabilities, U.S. analysts have tended to discount them in their analyses (if the United States has chosen not to pursue these approaches, how important could they be?), despite the fact that the capabilities they target (such as U.S. intelligence dominance) are often highly concentrated target systems that are relatively fragile and susceptible to damage.²⁶ Some intelligence, however, points to efforts by prospective opponents that are already underway in acquiring a range of key weapon technologies. Goliath must expect David to choose his own weapons and be ready to engage in asymmetrical battles.

Some countries will contemplate aggression where they either anticipate directly confronting the United States (e.g., a North Korean attack on South Korea requires, by treaty, a U.S. response, and U.S. troops are located in peacetime along the main invasion corridor), or anticipate the possibility of having to confront the United States (e.g., Russia attacking into Ukraine, given the U.S. assurances to Ukraine that were offered to get Ukraine to give up nuclear weapons). At the operational level, these countries will need to focus on countering U.S. strengths to avert disaster in their aggression. In such cases, we need to understand:

- What counters are possible?
- How effective these counters might be? Do they apply in only limited cases?
- Which of the more effective counters might be within the reach of specific opponents?
- How the United States might respond to and/or overcome these counters?

Example: Countering U.S. Air Forces

To deal with these issues, we propose a “threat-menu” approach. As illustrated in Figure 4.3, we begin (right side) defining a U.S. capability that opposition forces would need to counter. An opponent attempting to overcome U.S. air power might do so by a campaign that focuses on limiting the number of U.S. aircraft in a theater area, reducing the number of sorties that the aircraft can fly,

²⁵Other examples might include the FOG-M wire-guided antitank/antiaircraft missile, exploitation of U.S. assets such as the GPS system to perform highly accurate long-range bombardment, or the use of nuclear explosions in the outer atmosphere to threaten U.S. C³I.

²⁶The intelligence community representative to the RSAS Working Group has consistently pointed out that while U.S. intelligence collection platforms and communications systems tend to be relatively secure, the command and intelligence facilities in the theater are often relatively vulnerable, especially to well-orchestrated agent, SOF, or ballistic-missile attacks.

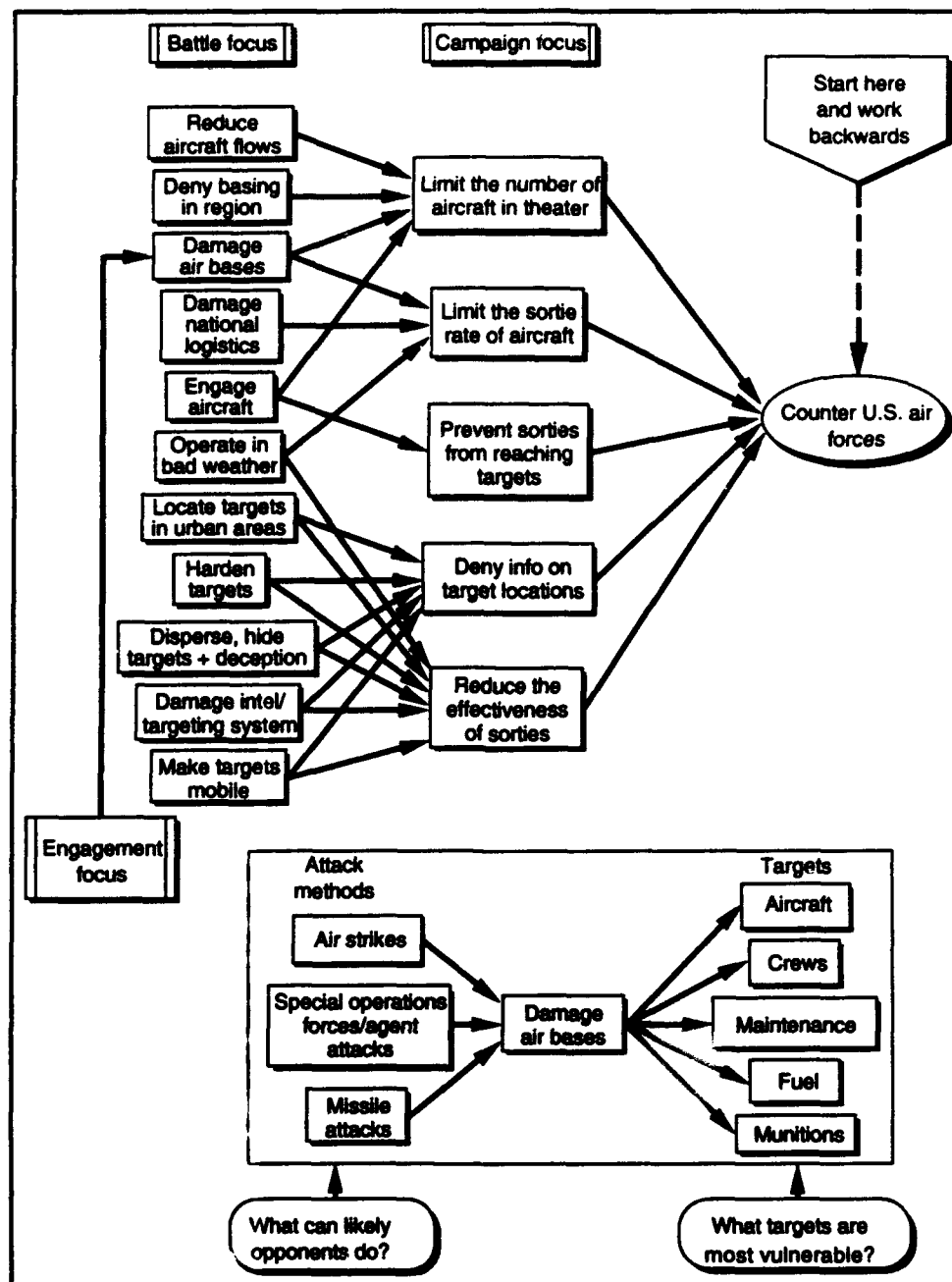


Figure 4.3—A Threat Menu

and/or limiting the effectiveness of sorties against targets. In turn, the number of sorties can be limited by "battle focuses" of damaging airfields, damaging national logistics (for example, destroying POL distribution and refining capabilities), or timing a conflict to correspond (to the extent controllable) with bad weather. Opposition attacks against our air bases are a particular concern,

since U.S. air forces will likely be located on a few, dense, high-valued targets. To damage air bases, a number of different kinds of attacks could be made on the airfields, and these attacks could target some combination of the assets associated with airfields. We refer to this approach as a threat menu because we have attempted to outline the variety of ways that an opponent might take to counter U.S. air forces; this is a menu because we believe that most opponents would choose multiple battle and engagement approaches, hoping to increase the potential of countering the U.S. capability. For example, an adversary might target U.S. airfields while interdicting the regional fuel supply and fielding a range of surface-to-air missiles with which to defend its forces and infrastructure. The appendix provides some examples of actions that could be taken.

The threat menu allows us to focus on the kinds of threats that might be posed, to decide which are significant and serious enough to consider in formulating potential threat environments (which constitute part of the warfare environment discussed above), and to develop intelligence collection requirements for a given theater.

To the extent that threats are truly asymmetrical, a different kind of military competition will result. Rather than the historical pattern of competition in largely symmetrical areas (e.g., tanks versus tanks or fighters versus fighters), analysts should expect opponents to pursue many different technologies in a combined-arms approach to deal with U.S. strengths (and not just looking for a single "silver bullet" to defeat U.S. forces). Thus analysis becomes complicated because it largely invalidates simple symmetrical capability comparisons (such as the traditional tank versus tank measures) and requires a battle or campaign orientation to make meaningful comparisons.

The Low-Tech, Irregular Combat Battlefield

Another approach, more correctly an extreme of the reactive approach, involves the U.S. opponent pursuing the kind of low-tech, irregular combat battlefield that the United States experienced in Vietnam (or more recently in Somalia). This kind of battlefield tends to occur in environments where U.S. opponents have little or no armor, having rather a predominantly infantry force structure.

Recognizing that the United States is able to operate on the high-tech plane, less capable adversaries seem compelled to respond to U.S. military force with avoidance of direct U.S. power, taking the initiative only in circumstances where they perceive that they can achieve some degree of advantage or are required to defend some vital asset. We refer to this characteristic of irregular warfare as the "ability to deny battle." This approach allows opponents to manage attrition and

maintain more satisfactory loss exchange ratios, where otherwise U.S. fire power would be devastating. It allows opponents to focus on creating engagements when U.S. and/or coalition forces are particularly vulnerable and which might become operational or strategic events because U.S. and/or coalition forces sustain relatively high losses. As a result of this mode of operation, low/no intensity combat operations, even if U.S. forces are attempting to perform active offensive roles, may be followed by a sudden surprise of a major engagement in which U.S. forces may sustain significant losses. Only very high concentrations of force in an area may be sufficient to prevent such attacks; even then, an opposition sniper or the opposition detonation of a truck bomb may negate U.S. efforts to maintain control of the situation.

In contrast to the high-tech battlefield described above, it is the low-tech battlefield in which the United States cannot be expected to maintain information dominance. Many of the U.S. intelligence systems are excellent at determining where large weapons like tanks and armored personnel carriers are located but have much more difficulty locating infantry, especially infantry that may often not wear uniforms and that appear from cover suddenly, only to disappear almost as suddenly. While the United States has had some luck historically in following key personnel through their use of communications systems, news reports from Somalia suggest that General Aideed, who avoided U.S. capture for months, was able to do so because he avoided phones and other systems that we could monitor, instead choosing to communicate by messenger and low-tech/power radio transmissions.²⁷

The opponent who pursues irregular warfare will generally have the initiative in combat operations against the United States.²⁸ This situation may be even more true in peace-enforcing situations where the U.S. rules of engagement may often limit U.S. forces to fire only when fired upon. Moreover, such an opponent may be able to largely negate the effectiveness of advanced U.S. weaponry by denying targeting information or by putting targets in areas the United States is reluctant to strike (because of concerns about collateral damage). The more options the opponent has for hiding forces, the more difficult will be U.S. combat operations; thus the availability of reasonable hiding places becomes a key characteristic of

²⁷ A recent report indicated that the relatively rapid response of Somali guerrillas to U.S. ranger operations occurred because Aideed followers near the Mogadishu airport used oil drums (following the ancient African tradition) to communicate that ranger teams had taken off and appeared to be heading for guerrilla targets. "Inside Mogadishu," *Time*, November 8, 1993, p. 17.

²⁸ The United States may be able to gain the initiative by identifying and striking targets with high value to the opposition (for example, locating the opposition leadership and attacking it). However, such operations will likely convey the initiative only transiently and, to the extent that U.S. forces must expose themselves in an area of heavy opposition presence to carry out such actions, may quickly yield the initiative to the opponent in some cases.

such warfare (thus, a desert is a less ideal terrain for irregular operations than a heavily forested or urbanized area). In this context, irregular warfare clearly is a stronger defense when forces are able to intermix with friendly populations and employ known hiding locations and much more difficult when executing power projection (where the terrain is likely not prepared and the local populations may well not be friendly).

The Combined Battlefields of the Future

We anticipate that the future battlefield experienced by U.S. forces will evolve as some combination of these approaches. In part, the combination will be a function of the force structure of U.S. opponents and of the terrain in which they operate. Few U.S. opponents will field forces capable of the high-tech operations described above, although to the extent that the United States will certainly have such capabilities, that description does provide a framework for contemplating prospective U.S. strengths and weaknesses.

If many prospective U.S. opponents fall closer to the low-tech image, then the United States can expect significant irregular combat confrontations, in which it appears to have the least relative advantage. This situation will be particularly true when U.S. forces are inserted into a peace-enforcing role, giving the opponents the advantage of carrying out largely defensive actions against the U.S. forces. To the extent that U.S. forces are introduced to stop an aggressor, that aggressor is less likely to be able to base his operations on irregular warfare because of the difficulties of this kind of warfare in power projection; therefore, in such circumstances, the United States may be able to gain much better control of the battlefield (against a low-tech opponent forced to fight predominantly regular warfare to achieve his objectives).²⁹

Whether dealing with a high-tech or a low-tech battlefield, in some ways the outcomes will be the same. Thus, both anticipate that the battlefield will be nonlinear, with lower densities of forces than historically anticipated. In both, forces will need to hide to survive, making rapid target acquisition and delivery of fires necessary to destroy opposing forces. In both, the key U.S. forces often will be long-range weaponry that the opponent will want to attack directly and that may be relatively concentrated in a few locations (such as airfields, artillery, and attack-helicopter bases).

²⁹The example of Vietnam may raise a question about this statement, and yet the difficulties faced by the United States in Vietnam were in large part a result of the combined internal/international character of the conflict, in which Viet Cong forces in particular were able to operate largely because of the "defensive" dimension of irregular warfare discussed above.

Nuclear, Biological, and Chemical Weapons³⁰

Nowhere will the asymmetries in approaches be more pronounced than in the respective readiness of potential regional adversaries to introduce the shadow of nuclear, biological, and chemical (NBC) weapons, and even their use, into a crisis. It is argued above that regional proliferators will not set out to acquire nuclear weapons specifically for confrontation with the United States (with the likely exception of North Korea). Many may conclude, however, that it would be foolish to get into such a confrontation unless so equipped. This argument applies with equal force to chemical and biological weapons, which are too often forgotten in the analysis of regional contingencies and may more than compensate for their lesser effectiveness by their relative ease of acquisition.

While various delivery means may be employed with nuclear weapons, most regional powers working on nuclear weapons seem to have chosen ballistic missiles.³¹ We also see some evidence of interest in cruise missile technology in many countries and suspect that cruise missiles may become an alternative delivery means during the next decade.³² The choices here are important; much effort has gone into controlling ballistic missile proliferation because of its clear tie to nuclear weapons, while much less emphasis has been placed on cruise missile proliferation. Cruise missiles appear to be the preferred delivery means for chemical or biological weapons and for some newer munitions such as fuel air explosives, because cruise missiles make it much easier to disperse these munitions in appropriate patterns around targets. Thus, we would expect substantial efforts to develop and deploy cruise missiles that could carry weapons of mass destruction.

As noted in Section 3, our gaming and analysis have shown that the attraction of nuclear weapons for many actual or aspirant proliferators may extend beyond the potential they offer for regional domination (although this motive will be dominant for some) and become the ultimate means for ensuring regime survival. Nuclear weapons provide the regime with a deterrent to attacks

³⁰The results of some of our games in this area are reported in Sam Gardiner, "Playing With Nuclear Weapons," *RSAS Newsletter*, RAND, February 1993, and Daniel B. Fox, "Atoms for Peace," *Military Science and Modeling*, August 1993. Some of RAND's other work in this area is found in Marc Dean Millot, Roger Molander, and Peter Wilson, "The Day After . . .": *Nuclear Proliferation in the Post-Cold War World—Volume 1: Summary Report*, RAND, MR-266-AF, 1993; Roger C. Molander and Peter A. Wilson, *The Nuclear Asymptote: On Containing Nuclear Proliferation*, RAND, MR-214-CC, 1993; and Bruce Bennett, "Countering North Korean Nuclear Proliferation," *Military Science and Modeling*, August 1993.

³¹This choice in part is a result of a lack of confidence by these countries in their air forces and the fact that they have not yet mastered cruise missile technology.

³²A "... Pentagon study said Syria, Iran and China are aggressively developing cruise missiles—the first ones are expected operational by the year 2000." "News Highlights," DoD's *Early Bird*, February 1, 1993, p. 16.

against it or a counter to those attacks should they occur (again, with the focus on attacks from regional powers more often than on attacks from the United States). In some cases, the intimidatory and deterrent motives may be hard to disentangle; nuclear weapons possession may be expected to provide a secure basis for expansionist policies, putting a ceiling on any losses should adventurism miscarry. Either way, whether the dominant impulse toward acquisition is aggressive or defensive, proliferators will rightly feel that their new status will impact the regional balance of power—as demonstrated most recently by the Japanese reaction to the prospect of a North Korean nuclear capability. They will also be conscious that, balance of power and insurance considerations apart, nuclear weapons will furnish them with the means, should they choose to use it, to decisively affect the course of any conflict in which they find themselves actually engaged, whether with the United States or a regional power—that is, the ability to create strategic events.

It is perhaps more likely than not that any future regional contingency in which the United States finds itself involved will be overshadowed by an explicit or implicit NBC weapons threat. The threat may be more in terms of potential than actual use, bearing on the crisis in the following ways:

- The adversary's possession of an NBC arsenal will be a strong disincentive for the United States to become militarily involved in the first place—especially if use, whether by terrorist or missile means, is credibly threatened against the U.S. homeland.
- Potential coalition partners, especially those geographically closest to the adversary, may be more difficult to enlist, fearing nuclear strikes from the aggressor.
- The possibility of tactical use may seriously inhibit U.S. deployments and cause major changes in operational planning. Concentrated deployments through a limited number of debarkation ports may have to be avoided; intense air operations from a small number of in-theater bases may have to be replaced by more dispersed and/or longer range operations; amphibious landings may have to be ruled out as presenting too concentrated and attractive a target.
- The United States may have to reconsider its doctrine of conventional theater/strategic attack, since it threatens the existence of the aggressor's regime, and the aggressor will likely look to nuclear weapons to assure that survival. Serious attacks against the aggressor's leadership may trigger a nuclear response that is intended to change the U.S. strategy and remove the threat to the aggressor's regime. The United States must, therefore, consider

other alternatives, to include abandoning conventional theater/strategic attacks in such a situation, limiting such attacks to nonleadership targets, or preparing to preemptively destroy the aggressor's nuclear weapons before starting its attacks on the aggressor's leadership.

- Even after a successful conventional campaign, coalition war aims may have to be circumscribed to avoid threatening the adversary's ultimate survival and thus potentially triggering a Samson response (the opponent self-destructing and attempting to take U.S. forces with him).

As suggested above, the actual use of NBC weapons would be a high-risk strategy for the adversary, but it should not, therefore, be regarded as excluded. As a major "strategic event," it might disrupt the whole political momentum of the U.S. response. It could certainly be expected to induce a pause on the battlefield, while Washington and other coalition capitals digested the implications. It might sow discord among coalition partners, as arguments ensued as to the appropriate response. Also, an adversary might calculate that in effect it would be a "no-added cost" option; given an increasingly advertised U.S. tendency to view nuclear weapons, as much as chemical and biological weapons, as lacking both utility and legitimacy, the adversary might reasonably calculate that the U.S. response to his own NBC use would merely be continued prosecution of the war against him by conventional means. The United States needs to consider whether it should take action to strengthen the perception of regional nuclear powers that their use of nuclear weapons will prompt a U.S. nuclear response.

5. How Analysis and Modeling Must Respond to the Future of War

To the extent that the above material properly reflects how warfare might evolve, we believe that military analysis and modeling need to change significantly to respond to the future (and to better mirror even the present). This section proposes a new approach to military analysis and then presents specific recommendations on modeling.

Requirements for a New Analytic Approach

The Cold War analytic approaches were simplifications that may have been appropriate for the time, but they are no longer appropriate for military analysis. We feel that six areas must change (each is discussed in more detail herein):

1. Analysis and modeling must **reflect the significant differences in the warfare environment that will exist between theaters**. Soviet doctrine and equipment, among other things, can no longer be the standard for analysis (while even on the Blue side, allowance must be made for possible involvement of coalition forces operating very differently from U.S. forces).
2. Analysis needs to **focus on strategic and operational events, variations, and uncertainties**. Simple, linear scenarios that suggest a best estimate of the course of combat will almost always be wrong, at very least because they ignore the element of surprise—important today, and surely more so in future conflicts. Analysis needs to draw out the *variety* of possible outcomes, at both strategic and operational levels, and identify the factors contributing to the key events that will determine what course the conflict actually takes and to which outcome.
3. To better understand the range of combat operations that could occur, we should adopt a **“counter-capabilities” approach to defining military threats**. This approach will develop threat menus that allow analysts to consider the range of possible threats and focus on the more likely and dangerous ones and how the United States should respond to them.
4. Given the uncertainties in force structure, doctrine, tactics, operational art, technological capabilities, training, etc., it appears inappropriate to develop sophisticated models of individual force interactions. It is even less

appropriate to ignore military operations (such as those of the special operations forces and interdiction against logistics) that may be hard to model but may have important effects on battles and campaigns. Instead, the community needs to **adopt a new approach of developing simple but more comprehensive models**, models that are sufficiently transparent so that trade-offs between inputs and key assumptions can be adjusted to reflect the impact of the variations discussed above.

5. Analysts need to **address issues associated with the regional shadow of weapons of mass destruction**. These issues no longer fit a clean, separable box, as they were treated during the Cold War. Instead, they may fundamentally affect the character of U.S. military strategy and operations, integrated with other military considerations.
6. Analysts need to **develop new procedures for presenting the uncertainties of their analyses to decisionmakers** and making these uncertainties more comprehensible. While decisionmakers are prone to preferring point estimates, these estimates will often be more likely wrong than right and in any case make the decisionmaking process appear naive because of its insensitivity to the uncertainties.

While the first impression that these points create is that analysis needs to be more complex, they really mean that analysis must emphasize the range of military phenomena that could affect outcomes and to do so, the modeling base likely needs to be simpler but broader. This is a tall order; the next several subsections suggest initial approaches for dealing with each of these five areas.

Handling the Differences in Warfare Environment

In Section 4 we argued that a new class of strategic and operational variables needs to be defined to cover the differences in warfare environments among theaters. These variables should not be thought of as inputs to a combat model but rather as characterizations of warfare environments that would give the analyst a basis for capturing the differences between environments. For example, when trying to define the military operations and doctrine of a country the strategic and operational variables include factors such as:¹

¹In any given regional assessment, one or more of the participants may consider using more than just one of the alternatives suggested here. Thus, the United States might use amphibious assaults as raids, as feints, and as part of the counteroffensive. Still, each kind of use requires an assessment of a different character.

- The concept of assaults (armor assisted by artillery, infantry assisted by artillery, infantry exploiting holes caused by artillery, . . .).
- The concept of breakthrough exploitation (roll-up flanks, penetrate in depth, raid, . . .).
- The concept of air defense (guaranteed intercept far forward, intercept as possible, selective intercept, ambush, . . .).
- The concept for countering surface naval forces (mining, shore-based defenses, submarine attacks, surface naval battles, maritime aircraft, . . .).
- The concept for amphibious forces (feints, raids, main arm of offensive, . . .).

These kinds of differences suggest completely different procedures for measuring the outcome of a given operation (and thus analysis of MRCs attempted without proper allowance for these differences is likely to produce misleading results).

Figure 5.1 helps to clarify the kind of effort that would be required to properly reflect warfare environments. Here, the columns reflect some of the contingencies identified in Figure 4.1, while the rows are an upper-level representation of the issues that require characterization. The rows need to be thought of from a top-down perspective: What is going to make a difference in the analysis and thus require explicit attention? The actual work that must be

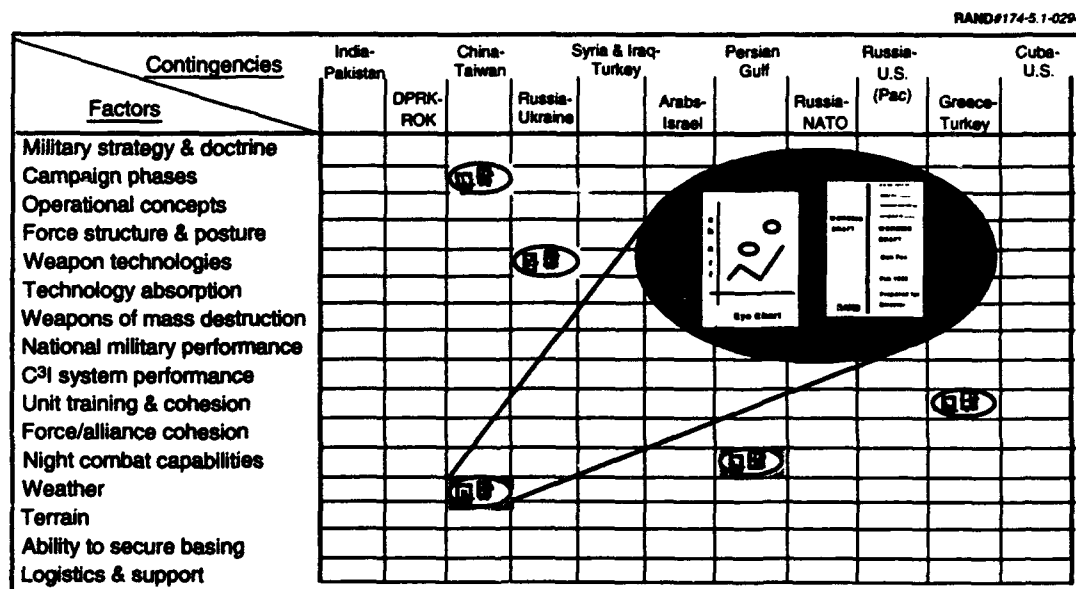


Figure 5.1—Key Characteristics of Regional Conflicts

done would go at least one level of detail below these categories, and perhaps two or three levels of detail below, as suggested for military operations and doctrine above. While some components may be simply characterized by a single graph or other mathematical relationship, more often we suspect that a series of rules and logic will need to be developed to properly characterize each element of the warfare environment.²

Following Strategic and Operational Events

We believe that future warfare will be dominated by strategic and operational events (key turning points), both on the battlefield and in analysis. At the strategic level, a breakthrough suffered in the theater, the loss of a capital ship, or even the downing of several helicopters with loss of life may fundamentally affect U.S. will and cause the United States to change strategy; analysis must capture the implications of the alternative strategies pursued thereafter. A strategic event could terminate U.S. intervention or compel it; it could fundamentally change participation in a U.S.-led coalition. At the operational level, a breakthrough on the ground or the establishment of air superiority in the air changes the entire character of analysis from that point on in the contingency. The United States has made serious military investments to achieve breakthroughs, air superiority, and other discontinuities in warfare, and analysts now need to be able to determine when they might be achieved.

Figure 5.2 provides a simple example of the sort of sequences of strategic and operational events that analysis ought to consider in the context of a full North Korean assault on South Korea. At the strategic level, the North Koreans would likely pursue a variety of attacks designed to convince the United States that this war will be exceptionally bloody and to test our willingness to sustain casualties. The United States could respond to such a North Korean approach in several ways. If the United States chooses to respond with a strong retaliation (perhaps striking North Korean command/control targets with nuclear weapons in response to North Korean chemical attacks on U.S. bases), then a number of strategic issues would need to be addressed, including how U.S. coalition partners or other interested parties would react to the U.S. response. No easy answers exist as to how such a campaign would evolve, but we at least need to understand what alternative courses of events could occur and their implications.

²We recognize that this development would require a substantial research effort; it would entail filling every entry in Figure 5.1—not just those that have entries for illustrative purposes. A substantial effort of this kind is inescapable if military analysis is to adequately reflect the diversity of possible post-Cold War contingencies.

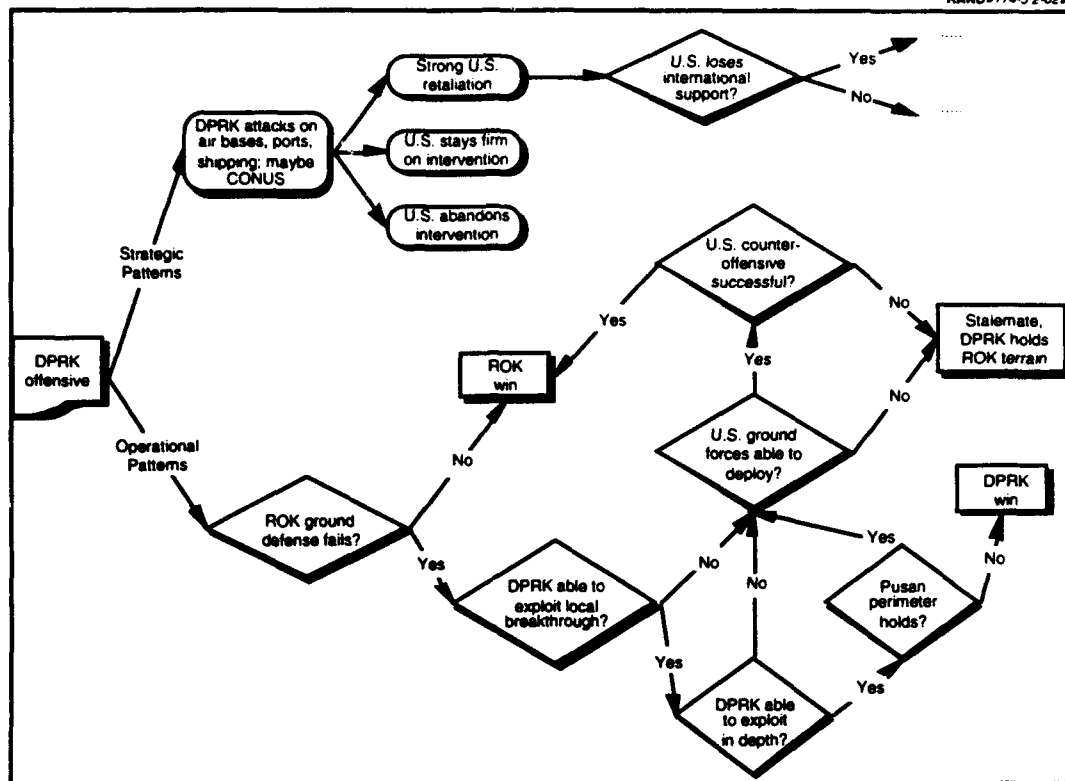


Figure 5.2—Following Strategic/Operational Events: A Simplified Example

At the operational level, we focus on issues such as whether the ROK forward defense fails. If it does not fail, South Korea should achieve a victory (though it may still have to fight for some lost territory); if it does fail, then the course of the conflict thereafter is fundamentally different (including the procedures that should be used in modeling), and the U.S. is faced with both operational and strategic issues.³ The analyst does not need to understand the daily course of assaults in the forward area as much as he needs to understand the conditions that could lead to the failure of the forward defense, and how these conditions are affected by the various uncertainties.

Analysis focused on strategic and operational events must, therefore, perform three tasks:

³On the strategic side, the analyst must assess the implications on U.S. will if the defense fails within a day or two of war initiation versus the implications if the defense holds for much longer or never does fail. While a U.S. decision to be involved would never be determined on this issue alone, it would likely be a contributing component to either the initial decision to be involved or a reassessment of that decision based on the course of events in the theater.

1. Define the prospective events and the sequences in which they might occur
2. Determine the circumstances that might cause the events and how they might be prevented or promoted.
3. Determine the likely implications of the events.

In addressing these issues, the military operations expertise and strategic awareness of the analyst become his key qualifications, whereas historically many analysts had more expertise in operations research than in military operations. The importance of this expertise is easily illustrated by considering the tasks in somewhat more detail.

Defining the Prospective Events

The prospective strategic and operational events in large part flow from the objectives of each side. For example, at the strategic level, one North Korean objective might be to deter or reverse U.S. intervention to support South Korea, and one U.S. objective would be to deter a North Korean attack against South Korea. At the operational level, the objective of a North Korean attack against South Korea might be the conquest of South Korea, which in large part might be achieved by a military objective of capturing Pusan within (say) three weeks. In turn, that military objective likely requires a breakthrough of the forward defenses within a week of attack initiation (otherwise, North Korean attrition in a continuing assault mode would make subsequent exploitation difficult), followed by an exploitation of the breakthrough in depth, and the defeat of any terminal resistance poised in front of Pusan (along the lines suggested in Figure 5.2). The key to the analysis of such a campaign is determining: will the forward defense fail, can exploitation be done, and can terminal defenses around Pusan be overcome?

How Might the Events Be Caused or Prevented?

The next task is to determine what might cause or prevent the events. Take, for example, the failure of the forward defenses in South Korea. What North Korean operations might cause such a failure (four alternatives are considered in more detail in the Appendix)? If the failure appears possible, how much less effective must North Korean forces be, or how much more effective must the South Koreans be, for the failure not to occur? Or how large a Republic of Korea (ROK) reserve would be required to contain a breakthrough? Or how much more effective would Combined Forces Command (CFC)—air and artillery forces—have to be to prevent a breakthrough? Naturally, an understanding of the North

Korean abilities to assault a defense is key to reaching conclusions here, but the focus of the analysis is raised to the operational level, and the uncertainties become a dominant part of what is examined. The analyst might conclude that some minimal capabilities of U.S. air forces are adequate for preventing a breakthrough or that the uncertainties dominate the outcome, and thus it must be carefully managed to achieve an agreeable outcome from the CFC perspective. Alternatively, the analyst might reach conclusions such as: "The defense will hold or its prospects be materially improved if only South Korean forces were better prepared for chemical warfare." The Appendix illustrates the character of such analysis in more depth.

What Are the Likely Implications of These Events?

From a strategic perspective, if the forward defense in Korea fails rapidly for some reason (for example, within the first day or so of combat), the outcome might seriously impact the U.S. decision to intervene. At the operational level, analysis of a campaign before the failure of the forward defense requires a focus on assault operations, whereas analysis thereafter requires a focus on exploitation operations; these two would have very different effects on attrition, force movement, vulnerability to opposing air operations, etc. The timing and the character of the forward defense failure would also have significant implications on subsequent North Korean operations (e.g., would the flanks of the penetration have to be heavily covered, or would the whole forward defense be incohesive?) and South Korean operations (e.g., can subsequent defensive lines be constituted, or has the forward failure shattered the cohesion of the ROK Army?).

The Counter Capability Framework

As discussed in Section 4, a threat environment is difficult to predict for any given regional conflict given the uncertainties of who might participate, what doctrine and operations they might employ, what new military technologies they might have acquired, how their military force structure might evolve by the time they engage in the contingency, etc. Given such uncertainty, it makes little sense to base U.S. preparations only on intelligence estimates of the developing "threat." Rather, if an adversary seeks aggressive operations that they believe will eventually involve the United States, logically, it should have prepared for such a conflict by developing capabilities to counter the well-known U.S. strengths. In Section 4 we proposed using a threat menu to define the range of actions that an opponent might take.

To develop threat menus, we propose using a counter-capability framework,⁴ which begins by positing that the U.S. strengths are known to our prospective opponent(s), and that given the initiative, these opponents will attempt to posture themselves and orchestrate future conflicts in ways that counter U.S. strengths, developing a new form of long-term competition for the United States.⁵ It proceeds to characterize the kinds of counters that could be used against U.S. strengths (including how effective the counters might be and any limitations that might exist on cases or environments in which such counters might apply), determines the likelihood that prospective opponents might succeed in developing and applying such counters,⁶ and examines ways in which the United States might deal with such counters. At the same time, it also attempts to characterize the strengths of prospective U.S. opponents and how the United States might counter them. It similarly considers limits on the cases or environments in which the United States might counter opposing capabilities, evaluates the likely U.S. ability to bring these counters to bear, and determines the kinds of strengths that the United States ought to be developing. The counter-capability framework thus considers aggressive and potentially diverse adversaries, and how they might interact with the United States through peacetime competition and wartime operations.

We have previously proposed the structure shown in Table 5.1 for defining counters to military capabilities.⁷ It differentiates four types of "counters," based on what they are and how they attack the opposing capability. We have employed this framework more generally⁸ and find it quite useful in characterizing counters to military capabilities, helping us to cover as many alternatives as possible in filling in threat menus.

Table 5.2 shows some of the types of counters that could be applied to overcoming U.S. air superiority, a clear U.S. strength. An initial appraisal of the likely effectiveness of each counter is included here. Note that we have done this

⁴An earlier version of this counter-capability framework was contained in Bruce Bennett, "A Counter-Capability Framework for Evaluating Military Capabilities," *RSAS Newsletter*, RAND, February 1993.

⁵This presumption is that future potential enemies of the U.S. could employ thought processes along the lines of DoD's work on "competitive strategies."

⁶For example, the most direct counter to U.S. air power would be strong air forces developed by our prospective opponents, but air power is a difficult capability to cultivate, and most prospective U.S. opponents appear unlikely to make much progress in this area. Alternatively, ballistic-missile technology appears much easier for most of our prospective opponents to develop and potentially apply against U.S. air bases. Thus, the counter-capability framework is a forward-looking approach that suggests kinds of counters that each side may employ, and the potential ability of various countries to do so, without focusing on the threat posed by any single foreign country.

⁷Sam Gardiner, "It Isn't Clear Ahead, But I Think I Can See the Edges of the Road: The Character of Future Warfare," *RSAS Newsletter*, RAND, November 1992.

⁸See, for example, Bruce W. Bennett, *Global 92 Analysis of Prospective Conflicts in Korea in the Next Ten Years*, N-3544, 1993 (especially Appendix B).

Table 5.1
Characterizing Counters to Military Capabilities

| Type of Counter | Meaning | Example: Opposing U.S. air superiority |
|--------------------|---|--|
| Parallel | Confront the capability with matched forces | Fighters for air-to-air engagements |
| Direct | Directly engage the capability | SAMs and air-defense artillery |
| Indirect (passive) | Protect against the capability | Target hardening and dispersal |
| Asymmetric | Attack the forces at bases or attack their support system | Attacks on air bases or the POL system |

table generically, not identifying a specific opponent; obviously, it could be revised and made specific to certain prospective opponents. The entries in such a table become one component of developing a meaningful threat menu.

The next step in counter-capability analysis is to examine each counter in more detail. For example, Figure 5.3 illustrates a more-detailed analysis of the air base attack component of Table 5.2. Here, we consider the forces that an opponent may have to carry out this counter, the limitations they face, and how the U.S. might respond against the counter. For example, to use ballistic or cruise missiles effectively against air bases, some form of advanced conventional munition or weapon of mass destruction is required (since conventional high explosives have too small an area of effect). The United States might respond to such a weapon system by using advanced Patriot missiles or by the proposed Theater High Altitude Area Defense (THAAD) antiballistic missile system. We then must consider how our opponents might counter our response; in this case, we have postulated that they: (1) may directly attack the air defenses with SOF and/or agents (for example, firing rocket propelled grenades [RPGs] or mortars at the Patriot radar from standoff positions), (2) may attack the airlift airfields through which such defensive systems would be deployed in the hopes of preventing the deployment or damaging the defense during deployment, or (3) may simply leave such short warning for the United States that we cannot deploy the defenses in a sufficiently timely manner. We could then look at U.S. responses to these counters and iterate until the possible battlefield development options become more clear.

In summary, the counter-capability framework allows a military analyst to look forward and develop a threat menu that in turn can be used to define a range of

Table 5.2
Possible Opposition Reactions to U.S. Air Superiority

| Type of Counter | Example | Likely Impact |
|-----------------|--|--|
| Parallel | Air-to-air engagements | Expect opposition will enjoy few successes and suffer major losses because of their poor pilot quality, and in many cases poor aircraft |
| Direct | Surface-to-air missiles | Expect some U.S. losses and virtual attrition |
| | Antiaircraft guns | May protect some areas against U.S. low-altitude operations and cause some U.S. attrition |
| Indirect | Hardening | Works well for some forces and facilities, but not for others (e.g., ground forces that must move or the electrical power system) |
| | Dispersing, hiding facilities | Will protect some facilities and forces against U.S. intelligence collection |
| | Mobility | May make some targets like ballistic missiles very difficult to locate and attack in a timely manner, especially if coupled with basing in hardened facilities or in populated areas |
| | Urban location of targets | May make the potential of collateral damage sufficiently high to preclude U.S. targeting |
| Asymmetrical | Airbase attack | Most likely procedure for seriously disrupting U.S. air forces—could be very effective if a combined missile and SOF force are employed |
| | Denial of regional bases | If air base attacks are successful, denial of regional bases would largely prevent the United States from bringing air power to bear in the theater |
| | Denial of littoral access by carrier battle groups | In areas with constrained waters, may be able to impose a standoff by naval forces that limits their involvement in the air war |
| | Attack en route aircraft | May be able to pose a significant threat at en route bases, especially against U.S. tankers and transports |
| | Attack in adverse weather | Reduce the number of aircraft sorties and the effectiveness of each sortie; increase aircraft losses; however, may affect opposition ground mobility |

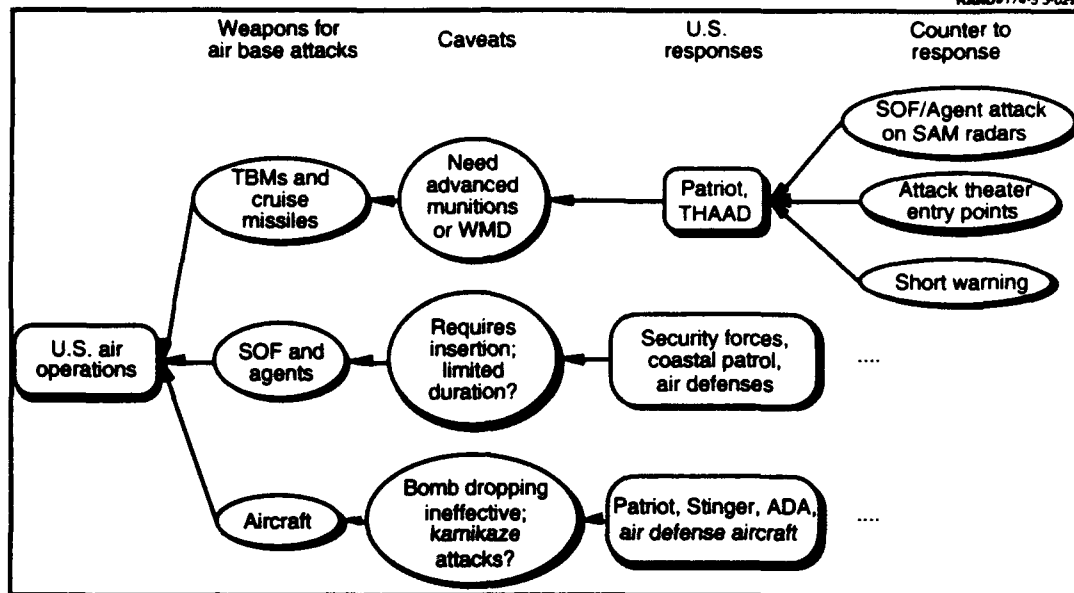


Figure 5.3—Considering Air Base Attack in More Detail

threat environments in which U.S. forces might be committed. The same approach can be applied to looking at ways that U.S. forces could be brought to bear against opposition strengths, recognizing that U.S. doctrine, force structure, and other attributes might also change in the future. As such, the counter-capability framework allows the analyst to consider warfare from a very dynamic perspective, consistent with the way in which warfare appears to be evolving.

Simplified Models

A range of simple models needs to be developed to address the conditions that might be conducive to operational and strategic events. The scope of these models would necessarily be wider than most theater-level simulations today, as they would include issues such as the effects of SOF attacks, operations of mobile missiles, the impacts of attacks on ports and airfields, the effects of logistics interdiction, and the effects of chemical and biological warfare. The models may be relatively simple in the sense that we are seeking an analysis of conditions in which key events might occur, and a simple model would be adequate if it could reach conclusions on military trade-offs. These models may come more in the form of a look-up table based on expert judgment rather than a formal model; for example, we might conclude that fewer than 5 SOF teams committed to

interdicting logistics flows in Korea will have negligible effects, but more than 50 deployed teams could have substantial effects on oil and munitions flows.

Care also needs to be exercised in applying existing, sophisticated models. For example, in ground combat a number of theater-level models employ killer-victim scoreboards as a way of estimating attrition to ground forces. These scoreboards allow for some of the issues associated with combined arms to be addressed but tend to be extremely complex representations. Moreover, they are calibrated to but a single combination of force structure, force size, doctrine, tactics, operational art, maneuver, C³I, training, proficiency, force cohesion, and so forth for each side, and only a single condition of terrain, defensive and offensive preparations, weather, etc. Usually, the only way to properly reflect changes in these factors is to derive a different scoreboard, which becomes excessively burdensome and computer-memory consuming. While the strengths of a killer victim scoreboard are desired, the community would likely be better served with a simpler, more transparent and validatable methodology that allows the analyst to easily consider the wide range of combat situations that might develop.⁹

In some conditions, simplification is easier. We refer to one such condition as "operational dominance," a condition in which one side is so superior in some area that its use of military force in that area is largely unopposed by enemy forces unless some "strategic event" intervenes to change the character of force employment. For example, in Operation Desert Storm, the United States and its coalition enjoyed operational dominance in air, ground, and sea operations. Operational dominance allows the analysis to be simplified: if one wished to analyze a future conflict in which the United States was expected to have the kind of operational dominance of the air that it had in Operation Desert Storm, it would make little sense to perform sophisticated air-to-air combat analysis of such an operation; indeed, the opponent would be more likely to deny such battle the way the Iraqis did in Operation Desert Storm (by not flying).¹⁰ In such a case, a very small percentage of losses per sortie or an assumption of essentially no losses would likely be adequate to cover this issue.

⁹There is no easy solution to such a requirement, but one approach that RAND has tried is described in Patrick D. Allen, *Situational Force Scoring: Accounting for Combined Arms Effects in Aggregate Combat Models*, N-3423-NA, RAND, 1992.

¹⁰The notion of denying battle is developed in more detail in Sam Gardiner, "It Isn't Clear Ahead, But I Think I Can See the Edges of the Road: The Character of Future Warfare," *RSAS Newsletter*, RAND, November 1992.

The Implications of "Regional" Weapons of Mass Destruction

Consideration of "regional" weapons of mass destruction needs to become an integrated part of regional contingency analysis. Regional assessments need to begin by establishing different boundaries and constraints in environments where weapons of mass destruction are known to exist or may exist: Conventional operations will simply not proceed without first considering these possibilities.

It seems increasingly likely that in the early stage of future conflicts, the United States will execute preemptive attacks on the nuclear (and chemical and biological) capabilities of opponents (probably using conventional weapons, at least at first). We must be able to analyze such options, including issues such as the likelihood of our knowing the location of the infrastructure for weapons of mass destruction¹¹ and the potential for collateral and environmental damage.

Opposition forces appear most likely to use nuclear weapons against two kinds of U.S. military targets: (1) U.S. forces early in their deployments (e.g., air and ground forces delivered to theater bases and to naval forces in adjoining sea regions), and (2) U.S. forces engaged in a counteroffensive. In either case, we need to better understand the potential impact of nuclear detonations. For nuclear attacks against early deployments, how much will throughput be affected, will key personnel be lost, and what is the likely impact on morale? For the counteroffensive, will force cohesion be lost? how badly will command and control suffer? will a substantial operational pause result? and will it be difficult to reestablish the momentum of the counteroffensive?

We must also consider the extent to which our regional allies are likely to be sensitive to fallout landing on their countries from a U.S. nuclear retaliation against an aggressor state. We need to be able to predict the likelihood that fallout will arrive on their country, and if so, of what intensity?

¹¹In the 1962 Cuban missile crisis, one option formulated for a response to nuclear missiles in Cuba was a so-called "surgical strike" to preemptively destroy the missiles. When asked about the likely effectiveness of the strike, "The Commander of the Tactical Air Command replied that the air strike would certainly destroy 90 percent of the missiles but that it was not possible to guarantee 100 percent effectiveness. According to Sorensen's record, 'Even then, admitted the Air Force—and this in particular influenced the President—there could be no assurance that all the missiles would have been removed or that some of them would not fire first.' Few assertions could have made the air strike less attractive to the leaders of the U.S. government." Graham T. Allison, *Essence of Decision: Explaining the Cuban Missile Crisis*, Little, Brown and Company, Boston, MA, 1971, p. 126. If uncertainty in such estimates will be key to national decisionmaking, analysts must be prepared to estimate that uncertainty.

Finally, we need better models¹² of chemical and biological attacks, including both immediate casualties (the dead and injured) and the effects on military operations thereafter (of having to wear chemical gear, not being able to drink the water, . . .).

Addressing the Uncertainties

The military analysis community needs to adapt to an era of uncertainty by developing better procedures for representing uncertainties. Quantitative estimates of uncertainty are hard to assimilate, but single-point estimates of contingency outcomes can be dangerously misleading. If nothing else, simply the description of the results of analysis needs to change to terms such as:¹³

- The addition of two divisions only modestly (or significantly) affects the ability of the defender to hold terrain [the relative magnitude of results].¹⁴
- The addition of two divisions allows the defender to hold terrain better provided that these divisions arrive before D+10 (10 days after the start of the conflict) in the theater [the robustness of the results].
- The addition of two divisions only modestly affects the ability of the defender to hold terrain, but adding an independent attack helicopter brigade to each corps across the front would significantly affect the ability of the defender to hold terrain, assuming attack helicopters can average at least 0.5 combat vehicle kill per sortie [the relative value of different force commitments].
- The addition of a new air defense weapon in a sector substantially increases the attrition caused to opposing attack helicopters, which in turn reduces the long-term damage the helicopters can cause, reducing the likelihood that the opponent will achieve a breakthrough and substantially reducing the destruction he could cause if a breakthrough is achieved [the interactions of factors].

In addition, analysts need to help decisionmakers develop strategies for managing the uncertainties, such as hedges, avoidance, etc. The statements above suggest some such procedures, but a more rigorous approach to managing uncertainties needs to be developed.

¹²As suggested earlier, such "models" may well come in the form of decision tables.

¹³These are taken from Bruce W. Bennett, et al., *RSAS 4.6 Summary*, N-3534-NA, RAND, 1992, p. 26.

¹⁴After each example, we state the more general issue addressed inside brackets, to clarify what we feel to be the kind of results appropriate for presentation.

Modeling Issues

The new approach to analysis suggested above requires the development of procedures to more fully capture the courses of strategic and operational events that might occur. Simply being able to develop diagrams such as Figure 5.1 would be important.

From a modeling perspective, theater combat models need to be modified to reflect the differences suggested by the strategic and operational variables discussed above. Thus, if infantry and artillery will dominate ground operations in a theater, combat rules should limit the mobility of the ground forces, make artillery a more effective killer of opposing forces (especially in causing personnel attrition), and attempt to refine the implications of counter-battery fires given the procedures available on each side for such operations.

Models must include explicit reactions to undesired battle outcomes. For example, if 3 percent of aircraft sorties are lost during interdiction, the air forces will likely modify operating procedures to reduce such losses, even at the cost of effectiveness against targets. Such adjustments can be anticipated in many areas; the examples in Section 4 (abandoning air bases struck with persistent chemicals, avoiding air operations below 10,000 feet, and concluding that a large amphibious operation is too risky) are just some of the effects that might occur. Further research is required to determine more systematically what could happen, and the effects that these limitations may imply. Then appropriate rules need to be added to theater combat models to reflect potential operational changes (though parameterized to vary the thresholds and the character of reactions, since these are far from certain).

Military models must facilitate the sensitivity testing of threats and other warfare uncertainties. Thus, they must be relatively fast running, easy to modify to different uncertainty cases (e.g., having parameterized rules of war and performance characteristics), and have outputs that make examination of the sensitivity runs meaningful in terms of both overall differences in results and the implications of the sensitivities on specific key events (like breakthroughs). The models should not be treated as rigorously quantified and able to produce results of many significant digits but rather as a vehicle for considering the uncertainty ranges.

Some other required changes include:

- Modeling of the implications of opposed U.S. deployments into theaters (e.g., the first C-141 arriving in theater is hit with an enemy SOF mortar)

round) and of short-term force viability (especially logistical viability) in such an environment.

- Better models of personnel attrition (including disease and nonbattle injury rates¹⁵), and of collateral damage to civilians (including some form of data to support such estimates).

¹⁵The Department of Defense is in the process of estimating future medical requirements for MRCs in response to a congressional request. The estimates to date suggest that disease and non-battle injuries will clearly dominate the medical requirements, at least in terms of the scenarios they have considered. Thus, we may not be able to ignore these.

6. Conclusions

The central purpose of this report has been to argue the need for military analysis and modeling to develop in new directions, so as to better reflect the likely nature and circumstances of the major conflicts in which the United States could become involved in the post-Cold War world.

We have sought to illustrate some of the deficiencies of current modeling and analysis techniques in relation even to "traditional" types of major conflict—and to point up how the evolving nature of future warfare will widen the gap between reality and our current methods and tools for representing it. Extensive war gaming of a range of possible future major regional contingencies has underlined that future U.S. adversaries should be expected to draw appropriate lessons from Operation Desert Storm. Realizing the futility of any strategy that rests on head-to-head engagement with the world's most powerful armed forces, they inevitably will seek alternative means to counter and defeat the United States.

At the operational level, these means will likely include the adoption of a range of innovative, asymmetric approaches to thwarting key U.S. strengths. At the strategic level, the adversary will seek to manipulate the political and strategic context of the conflict so as to inhibit the bringing-to-bear of decisive U.S. force and to sap U.S. commitment and will. The threat, or even use, of weapons of mass destruction could play a significant role in this context. These reflections, combined with the wide variety of theaters and circumstances (political and physical) in which U.S. forces might need to become engaged, suggest that such conflicts will be characterized by varied and uncertain conditions, by new patterns of warfare, by asymmetrical battles, and quite possibly by the shadow of weapons of mass destruction.

We have argued that analysis and modeling need to be able to encompass these new variables and find methodologies to represent the diversity of factors that affect each facet of the conflict and the uncertainty of their interaction. The new approach needs to recognize the importance of strategic variations between conflicts, the likely adoption of asymmetric tactics and strategies by the adversary, and the significance of casualties and weapons of mass destruction. It needs to find better ways to represent uncertainty, and it needs to focus on approaches and techniques that an adversary might seek to achieve a decisive

evolution (a "strategic" or "operational" event) on the battlefield or in the campaign. We recommend the use of a "counter-capabilities" approach to define possible threats, propose a "threat menu" technique for evaluating ways in which opponents might seek to counter key U.S. capabilities, and illustrate how the success of such approaches could contribute to the overall outcome of the battle or campaign.

These last suggestions, however, represent only some initial first steps toward making good the deficiencies we have identified. We believe that a proper understanding of the likely course and nature of future major regional contingencies in which the United States may become involved will require both a better basis of military science from which to perform modeling and analysis and a better grasp of the future of warfare. We accordingly recommend that the DoD:

- Pursue the development of military science, which would support military analysis and modeling just like basic science supports applications in mathematics and physics. Such efforts are essential for developing a more consistent and reasonable basis from which to perform military analyses.
- Develop a program of research, war-gaming, and discussion seminars throughout the Department of Defense aimed at developing a shared understanding of the future of warfare, from which decisionmakers and analysts can then operate.
- Adopt new analytic procedures appropriate to the changed major regional contingency environments we face. These procedures need to take account of asymmetric strategies to positively address uncertainties and risks, to show the impact of changing circumstances and technologies, and to provide a basis for properly modeling these new environments.

Appendix

Taking the Proposed Analytic Approach a Step Further

In Section 5, we proposed a new approach for military analysis that focuses on strategic and operational events. We also proposed that military threats be analyzed using a threat menu. This appendix endeavors to amplify these approaches by showing how an operational event would be analyzed. A more complete example of using a threat menu is included. It also describes an approach for developing threat menus, which we refer to as the "counter-capability" framework. This amplification is exemplary as opposed to exhaustive, and intended to provide a better sense of the kinds of issues that should be considered.

Figure A.1 is a simplified series of operational events that might define a campaign in Korea, assuming a North Korean offensive. The first operational

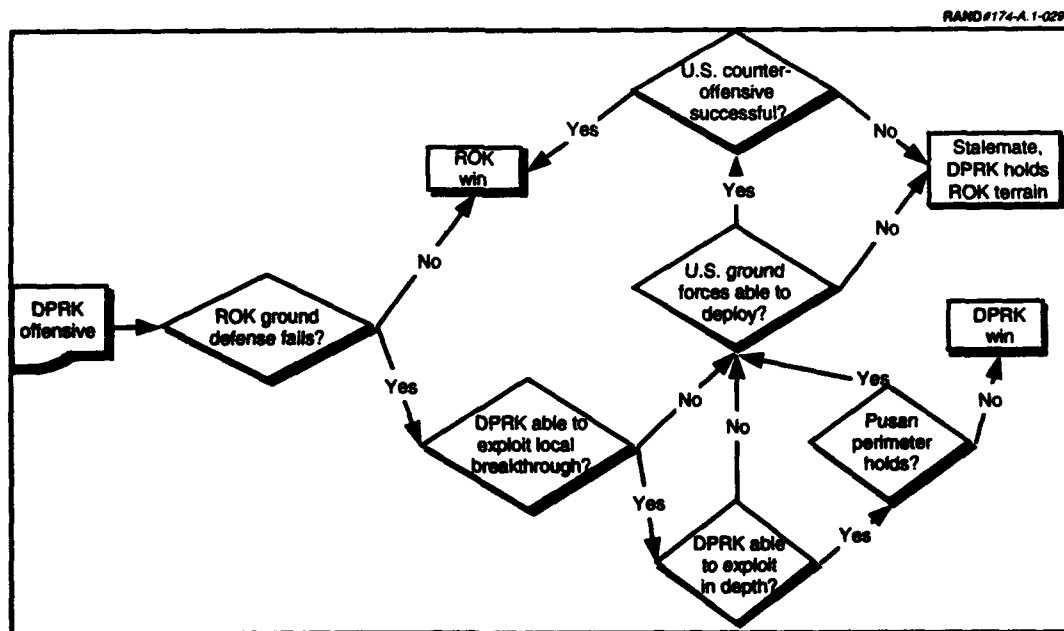


Figure A.1—Following Operational Events: A Simplified Example

event in the series is whether the ROK forward ground defense fails.¹ To analyze this event, we must first understand the nature of the ROK forward defenses, then consider the North Korean options for assaulting these defenses, and conclude by examining coalition responses to the North Korean operational concepts.

The Nature of the ROK Forward Defenses

The forward defenses in South Korea are remnants of the Korean War. In that war, the CFC organized its operations around a series of phase lines across the Korean peninsula, advancing or falling back from one to another. The defensive lines in South Korea today begin on the south side of the demilitarized zone (DMZ) and extend south for 40 to 80 kilometers. Because Seoul exists only about 40 kilometers from the DMZ, the lines are closer to the DMZ in the west (above Seoul) and longer in the east. Table A.1 summarizes the defensive lines and their forces (the MDL is the military demarcation line, or the center of the DMZ), which are shown here to give at least a rough approximation of the North Korean requirements to attack these lines. The active divisions probably would be in defensive positions within, at most, hours of warning (many are in position in peacetime), and many of the reserve forces would be in position within a few days of mobilization. In addition to the forces mentioned in this table, a number of reserve divisions defend Seoul and the rear areas behind the forward defenses.

The South Korean defensive lines tend to be relatively shallow (almost linear) in the west but have more depth in the east (the Taebek Mountains), especially along the roads through the mountains. The guard outpost position (GOP) is primarily established as an early warning line, as well as to prevent North Korean infiltrations. The main defensive lines are forward edge of the battle area (FEBA)-Alpha through FEBA-Charlie, plus an intermediate line that goes by various names in some defensive sectors.

For the forward ROK defense to fail, North Korea would have to create holes in all these defensive lines within essentially the same sector or sectors (because of the limited cross-sector mobility in South Korea, which would be an impediment to the flow of North Korean logistics, if not to combat advances). The North Koreans would also have to take some action to prevent the reserves from being

¹Throughout this appendix we refer to the forward "ROK" defenses. The vast majority of ground forces positioned north of Seoul are South Korean forces, with only the equivalent of two U.S. mechanized brigades in the area. While these brigades clearly contribute to the forward defense, they are located in only one defensive sector, and the success or failure of the forward defense, in reality, is primarily a function of the performance of ROK ground forces, as supported by allied air forces.

Table A.1
South Korean Defensive Lines

| | Distance from MDL (km) | Manned by |
|--------------|---------------------------|-------------------------------|
| GOP | 1-2 | Parts of FEBA-Alpha IDs |
| FEBA-Alpha | 10-20 | 12 active IDs+ |
| FEBA-Bravo | 20-40 | 5 active IDs |
| FEBA-Charlie | 30-60 | Reserve IDs+ |
| FEBA-Delta | 40-80 | Reserve IDs |
| Reserve | 20-80 | 4+ Mechanized Divisions, etc. |

brought to bear, would have to cover their flanks, and would have to neutralize the allied supporting fires (aircraft, attack helicopters, and long-range artillery). South Korean doctrine is very heavily offensive; thus, the North Koreans should expect counterattacks whenever they leave an exposed flank or an inadequately covered frontal position.

Analyzing an Operational Event: Will the ROK Ground Defense Fail?

We next postulate alternative North Korean approaches to overcoming the forward ROK defenses. While the entire North Korean campaign plan would contribute to this military objective, we focus on the actions that would primarily contribute to the failure of the forward defense. The specific North Korean military objective would be to accomplish a substantial breakthrough.² In simple terms, the North Koreans could take at least four approaches to accomplish this objective:

1. *"Infiltration" Operational Concept*—Use light infantry supported by artillery to infiltrate the forward defenses and penetrate them in depth, collapsing the defense by destroying command/control and other targets in the rear area.
2. *"Infantry Corridor" Operational Concept*—Use artillery to create breakthrough corridors in the defense, and employ infantry forces supported by armor to assault these corridors, breakthrough, and exploit to the next defensive line.

²North Korean doctrine on breakthroughs appears to resemble the Soviet doctrine in some ways. The Soviets conceived of a breakthrough as really two battles: (1) the break-in battle in which one penetrates the line of defense and (2) the break-out battle that ruptures the remaining defense. The Soviets planned to use infantry as the break-in force and armor for the break-out force, much as the North Koreans appear to think of such operations (although the North Koreans may favor depth of penetration over spreading and envelopment as the mechanism for the break-out battle). The British employed this strategy at El Alamein. Using armor for the break-out is not the same as for exploitation, although the break-out might lead to a pursuit battle.

3. *"Armor Corridor" Operational Concept*—Use artillery to create breakthrough corridors in the defense, and employ heavy forces supported by infantry to assault these corridors, breakthrough, and exploit to the next defensive line.
4. *"Artillery Terror" Operational Concept*—Use a combination of fuel air explosives (FAEs) and nonpersistent chemical weapons against all ROK positions in the forward area to cause high attrition throughout the depth of the defense and to destroy the cohesion of the defense because of the terror caused by these weapons; exploit through the defenses using infantry and armor.

Of these, many analysts commonly consider the middle two to be the likely North Korean operational approach (some analysts favoring one, and some favoring the other), while the other two are more innovative and not commonly considered in the community.

Table A.2 compares the four operational concepts in terms of how they might lead to a failure of the defense, and some of the keys required for each concept to succeed. Let us consider each operational concept in more detail.

Table A.2
Comparing Possible North Korean Forward Attack Operations

| Operational Concept | Mechanism for Defense Failure | Keys to Attacker Success |
|---------------------|---|--|
| Infiltration | Cohesion of forward units fails as command/control and supply flows are lost | Weak positions in the ROK defenses to infiltrate, brittleness of forward ROK units, inadequate ROK reserves |
| Infantry Corridor | Defense begins to rupture as penetrations develop and penetration corridors broaden | Sufficient artillery to create holes in the defense, assault forces capable of penetrating and broadening the holes, lack of ROK reserves or fires to plug the holes |
| Armor Corridor | Defense begins to rupture as penetrations develop and penetration corridors broaden | Sufficient artillery to create holes in the defense, assault forces capable of penetrating and broadening the holes, lack of ROK reserves or fires to plug the holes |
| Artillery Terror | Cohesion of defense disintegrates across the front because of attrition and terror | Sufficient warheads to cover all forward defensive positions, maneuver forces able to exploit against negligible opposition, no protected ROK reserves, inadequate preparation of ROK forward forces |

Infiltration

The infiltration operational concept presumes that an indirect approach will cause the failure of the forward defense: it presumes that enough damage done by North Korean forces in the ROK rear will cause the forward units to collapse. As a result, the indirect character of this concept makes it the weakest of the four considered. It is one where North Korean forces (at least those projected into the ROK rear) would likely be most vulnerable if the forward units did not collapse.

Operationally, this concept would involve North Korean infantry units infiltrating into the ROK rear, at least as deep as FEBA-Alpha. Presumably many of these infiltrators would seek weak points in the ROK defenses to infiltrate and in some cases would be inserted via tunnels under the DMZ. To succeed, these forces potentially would have to overcome the ROK forces on FEBA-Bravo and in other positions behind FEBA-Alpha, since the ROK offensive philosophy would almost demand that the more rearward ROK forces counterattack any North Korean forces that successfully infiltrated behind FEBA-Alpha. While little ROK artillery would play in these battles because it is positioned in the contested area, just the maneuver forces in each ROK corps sector could provide a division or more in infantry forces to such a battle and in many corridors an armored brigade. Thus, it seems likely that a North Korean force of at least two infantry divisions would have to be infiltrated behind FEBA-Alpha in each corps sector. It would be difficult (impossible?) to insert forces of this size through holes in the forward ROK defenses, and it might be difficult to insert such large forces through the tunnels in a sufficiently timely manner to constitute a viable force before the FEBA-Bravo forces arrive.³

Thus, not only is the breakthrough mechanism weak, but the actual feasibility of this operational concept (given the ROK defensive positions) is questionable. The natural positioning and training of ROK forces appear adequate to handle such a threat, especially if supported by the air forces of the CFC.

Infantry Corridor

"At the onset of hostilities, artillery units could launch massive preparatory fires at South Korean defensive fortifications and along major routes of advance. . . . North Korean infantry and armored elements of the first-echelon divisions of the

³While some sources suggest that a North Korean infantry division could in one hour pass through the kinds of tunnels that have been discovered, most military experts believe the throughput would be limited to less than half that speed. See Korean Overseas Information Service, *Undermining Peace: The Fourth Infiltration Tunnel*, 1990, especially the descriptions of Tunnels II and III.

forward conventional corps would attempt to penetrate the allied forward defense. The mechanized corps, brigades augmented with attached self-propelled artillery, and combat support elements would attempt to pass through any openings the front-line corps create. The mechanized corps quickly would penetrate deep into South Korea, bypassing and possibly isolating many allied units."⁴ Because the North Korean first echelon divisions are infantry divisions, only about 10 percent of the forward maneuver battalions would be armor (the rest infantry), which would make the initial assaults heavily dominated by infantry.

There appears to be little doubt that North Korean artillery could create a hole in the defenses of at least the GOP and FEBA-Alpha. North Korean artillery superiority in the theater should provide perhaps 100 tubes of artillery per kilometer in the main attack sectors, and a large fraction of these would be protected in hardened, cave sites where they are minimally vulnerable to counter-battery fires and air interdiction. Analysts consider that tens of artillery shells could land on each meter of the defensive lines in the main attack sectors, which should be sufficient for a significant degree of suppression, even with conventional munitions. The use of FAEs or chemical munitions (presumably nonpersistent, so as not to impede the assault forces) would accelerate this operation and make the creation of a hole more assured.

South Korean forces manning the forward defensive lines should be able to exact a toll on the North Korean attackers except in the suppressed sectors; even then, some opposition would be expected from adjoining sectors. Moreover, minefields in the forward areas should also exact an attrition price against the North Korean attackers. If North Korean artillery fire is adequate, however, the North Korean attackers will likely not be prevented from achieving their objectives by the forces in the forward defenses.⁵ Instead, South Korean artillery and CFC air are the keys to defeating the North Korean infantry assault. The ability of South Korean artillery to perform this role is a function of:

- Efforts of North Korea to suppress and destroy South Korean artillery with counter-battery fire and other means of attack.⁶

⁴Defense Intelligence Agency, *North Korea: The Foundations of Military Strength*, October 1991, p. 58.

⁵In part this judgment is based on the limited mobility of the forward South Korean forces (especially if movement is attempted under North Korean artillery fire guided by North Korean SOF or other artillery observers), limiting the South Koreans' ability to laterally move forces or employ reserves to cover sectors that have been heavily damaged in the North Korean artillery attacks. North Korean FAE rounds could also be used to suppress the forward minefields, although in the process destroying some of the natural vegetation cover they would otherwise want for their forces.

⁶In the Korean War, a major objective of North Korean and Chinese infiltrators was the destruction of artillery—a lesson likely remembered in North Korea today.

- Performance of North Korean infantry forces in assaulting ROK positions.
- The degree to which South Korean command/control can bring the artillery to bear against the key North Korean attack sectors. This, in turn, is affected by the character of the South Korean command/control system (and its ability to responsively plan and execute artillery fires), and the ability of North Korea to disrupt the South Korean control of the artillery.
- The ability of South Korean artillery to relocate when threatened by North Korean maneuver and again bring fire to bear effectively (including issues such as the supply of artillery munitions at alternative sites to the rear).

CFC air forces' ability to perform this role is a function of:

- Efforts of North Korea to suppress and destroy CFC air forces on their airfields.
- Performance of CFC air forces at night and in weather that often prohibits visual acquisition of opposing targets.
- The degree to which South Korean command/control can bring the air to bear against the key North Korean attack sectors. This, in turn, is affected by the character of the South Korean command/control system (and its ability to responsively plan and execute air attacks) and the ability of North Korea to disrupt the South Korean control of air forces.
- The ability of the North Koreans to actively defend their assaults with air defense weapons and fighter aircraft.

Clearly these factors have many components; some are detailed below as part of the threat menu discussion on opposing CFC air forces.

To the extent that North Korean armor is committed to exploit breakthroughs, the exploitation phase of this alternative will begin to resemble the armor corridor concept discussed below.

Armor Corridor

Many analysts of a prospective Korean conflict consider that the most likely North Korean operational concept against the forward defenses would be to use artillery to create holes in the ROK defensive lines and then have heavy (armored and mechanized) forces assault these defenses to rupture the holes, exploit the local breakthroughs, and then advance for the assault on the next defensive line.

As discussed for the infantry corridor above, little doubt exists that North Korean artillery can create holes in the South Korean defensive lines. For armor to assault these holes and develop breakthrough corridors, however, is difficult during most parts of the year. The forward areas of South Korea have very few roads, and the off-road terrain is generally either mountainous or dedicated to rice production, neither of which allows for much use of heavy forces. Usually assaults would have to be funneled up the few roads, with most of the South Korean defensive positions and artillery fire oriented on these avenues of advance, likely leading the significant North Korean losses. Only during the winter when the ground is frozen hard (perhaps two months each year) does this relationship change, allowing broader armor maneuver and then only in the relatively flat parts of Korea (primarily in the west).⁷ Defenders should be highly lethal against heavy attackers so channelized, making such an approach questionable for North Korea.

Artillery Terror

If it were clearly possible to strike most of the ROK defensive positions, command control, logistics, and reserve facilities with a combination of fuel air explosives and chemical weapons, the attrition and the terror caused could largely melt the forward ROK defenses much as the shock factor did in 1950 at the beginning of the Korean War. In that case, military personnel largely abandoned their vehicles and heavy weapons and pursued individual retreats to the south. From the North Korean perspective, such an outcome would be ideal because:

1. It would not have to test the effectiveness and cohesion of its army in assaults at the beginning of the conflict but could rather allow it to harden in conditions resembling a breakthrough.
2. It would establish substantial momentum and should be able to rapidly reach positions abreast of Seoul (probably crossing the Han River within a few days).
3. It would make air interdiction of the advancing North Korean forces difficult because of the nonlinear battlefield that would ensue (although CFC forces may be more willing to pay the price of fratricide to slow the North Korean advance in such a circumstance).

⁷ Meanwhile, winter provides the optimal weather for air operations, in direct trade-off with the maneuverability of armor. Summer offers the worst weather for air-to-ground attacks.

Table A.3 makes a rough approximation of the artillery requirements for this operational concept.⁸ Of the rounds identified, roughly half are required in the area that can be reached by normal artillery, and half would have to be reached by longer range artillery (such as the North Korean large multiple rocket launchers—MRLs—and their Koksang gun).⁹ Assuming that the North Koreans have the equivalent of 2,000 152-mm guns/howitzers to attack the forward area, and these could fire an average of two rounds per minute, it would take less than half an hour to accomplish the forward component of this attack. Assuming that the North Koreans have the equivalent of 200 240-mm MRLs (each with 12 rounds) to attack the rear area, and these could fire an average of once every 30 minutes, it would take approximately 15 hours to accomplish the rear component of this attack. The longer period in the rear is not inappropriate, as reserve units would not likely all be in position at the initiation of the bombardment (which may suggest a shifting of the bombardment from some defensive positions to lines of advance for the reserve forces), and many of the rear targets are fixed and not time-urgent. Indeed, ongoing strikes in both the forward and rear areas would be desirable to continue the terror and erosion of force cohesion. Thus,

Table A.3
FAE/Chemical Artillery Rounds Required for "Artillery Terror" Concept

| Target | Linear Length (km) | Separate Targets | Rounds Required |
|---------------------|--------------------|------------------|-----------------|
| Defensive Lines | 1,200 | | 120,000 |
| Other Positions | | 500 | 1,500 |
| Artillery Positions | | 5,000 | 15,000 |
| Reserve Forces | 150 | | 9,000 |
| Command/Control | | 300 | 900 |
| Logistics | | 500 | 1,500 |
| Total | | | 147,900 |

⁸The basic round considered is a 152-mm artillery round or a 240-mm MRL round; both apparently have a similar warhead weight. Estimates of FAE lethality are derived from unpublished work at RAND. These requirements could be low if the artillery or MRLs are not sufficiently accurate. The effectiveness of chemical warheads is also a function of the weather, with the lethal radius and pattern being changed by rain, winds, and other factors. Lethality will also vary depending on whether nonpersistent or persistent agents are used: persistent agents fired at deeper defensive lines could be expected to cause casualties to personnel withdrawing from forward defensive lines, especially if the ensuing terror causes the personnel to abandon chemical gear as they individually withdraw. As a very rough approximation, we have assumed here that on net the chemical weapon effects will be roughly of comparable magnitude to the FAE effects.

⁹The North Koreans could also use FROG and Scud missiles and air strikes against some of these targets.

the real question becomes whether the North Koreans would have the indicated number of FAE, chemical artillery, and MRL rounds.

If the North Koreans have sufficient artillery and MRL rounds to carry out these attacks, a very large number of casualties would result (likely including forward U.S. military personnel). It is not possible to predict whether the combination of attrition and terror would cause the forward defense to fail; even if it did not, the forward defense would clearly be left with many holes, reverting to the "armor corridor" or "infantry corridor" operational concepts. If these attacks were to cause the forward defense to fail, North Korean ground forces would be left with a breakthrough-like condition in which to operate, requiring some engagements with surviving ROK units and individuals, but not an integrated defense. While infantry forces might advance to secure the initial defensive positions, the North Koreans would likely want to pass armored and mechanized forces through to rapidly exploit the condition and achieve appropriate crossing points on the Han River. If the artillery bombardment has successfully impaired not only the fixed defensive positions but also the ROK artillery and mechanized reserve forces, the CFC air power may be the only way to respond.¹⁰

CFC Responses

Table A.4 summarizes the CFC responses to the North Korean assault options considered. CFC appears to have adequate responses for the infiltration operational concept, more difficult responses to the infantry corridor, good responses against the armor corridor (except in the west in the winter), and poor responses to the artillery terror (although this issue certainly bears further research and analysis). In all but the infiltration case, CFC fires play a major role in countering the North Korean attack. As a result, the ability of CFC to bring its airpower to bear is warranted of further examination.

Some Threat Menu Options for Countering U.S. Air Forces

If CFC airpower would play a major role in countering a North Korean assault and breakthrough, the North Koreans must plan to counter CFC air forces. In all likelihood, a range of counters would be employed as part of a combined arms

¹⁰ A very high percentage of ROK heavy weapons is located in the forward defenses. If many of these weapons are damaged or abandoned, attempts to reform a ground defense below Seoul will largely involve infantry forces with little heavy equipment and no significant number of antiarmor weapons. CFC would largely have to depend on air power for killing armor.

Table A.4
CFC Responses to North Korean Assault Concepts

| Operational Concept | Ground Force Response | Air Force Response |
|---------------------|--|---|
| Infiltration | Forces on FEBA-Bravo should be able to contain | Provide marginal support with close air support (CAS) |
| Infantry Corridor | Use defensive lines to slow advance; use artillery to maximize attrition; if required, counterattack with heavy reserves | Provide important CAS against assaulting forces while focusing BAI on follow-on exploitation forces |
| Armor Corridor | Use preestablished armor traps for attrition; employ heavy reserves in a counterattack; focus artillery on the roads | Provide critical CAS and Battlefield Air Interdiction (BAI) support, especially against road-bound vehicles |
| Artillery Terror | Attempt to reform army, but cohesive response may not be possible | Only clear option for response; must be devastating against opposing heavy forces, sufficient to stop their advance |

effort. For example, in a recent war game,¹¹ the adversary's strategy to counter U.S. air forces included:

- A short warning attack to limit the flow of U.S. aircraft into the theater by D-Day.
- Coercion of U.S. regional allies to prevent them from allowing the basing and operations of U.S. aircraft.
- Attacks on airfields in the theater with SOF, ballistic missiles, helicopter regiments, marine forces, and aircraft to kill pilots and crews, damage aircraft maintenance and logistics capabilities, and destroy aircraft; attacks were focused on bases with high-valued U.S. aircraft such as tankers, transports, and C-3 aircraft.
- Attacks on ROK POL storage, refining, and distribution to limit the fuel available at airfields.
- Use of selected air-to-air engagements to cause attrition to U.S. aircraft and disrupt U.S. attacks on targets (recognizing that heavy losses will likely be sustained).

¹¹Other recent war games have included somewhat different approaches, including combined mining, antishipping missile, submarine, and aircraft threats sufficient to impose some degree and duration of standoff by U.S. carrier forces, to limit their participation in the air war.

- Use of surface-to-air missiles and air defense artillery to cause attrition to U.S. aircraft and disrupt U.S. attacks on targets.
- Use of air raids on U.S. and other friendly targets (especially Seoul) to motivate stronger defensive counterair operations and thus reduce apportionments against enemy targets.
- Initiate conflict in a season with consistently poor weather conditions for air operations.
- Hardening, dispersal, and hiding of targets, and making many targets mobile to complicate U.S. targeting.
- Attacks on the U.S. and coalition C³I system (by SOF, long-range artillery, and missiles, to include the use of chemical weapons) to disrupt the formulation of an effective air tasking order.
- Attacks on airfields on the periphery of the region to damage high-valued U.S. aircraft such as Airborne Warning Control System (AWACS) and Joint Strategic Target Attack Radar System (JSTARS).
- Selected long-range fighter sweep operations against AWACS, JSTARS, and similar aircraft.

These options suggest some of the elements of a threat menu that appear feasible and within the interests of North Korea.

Even discussions of North Korean actions at this level of detail may require further refinement to understand the full implications of possible actions. For example, to the extent that North Korean armor is channelized and vulnerable to CFC air forces in the forward areas, "hiding of targets" might include long tunnels into South Korea that hide North Korean armor during its forward staging and allow it to be committed in the midst of a nonlinear battlefield before interdiction is possible. For example, if on D-Day North Korean armor emerged below the main defenses at FEBA-Alpha, it could add to the confusion and disruption of the artillery terror concept and prevent interdiction before commitment (the ideal time for interdicting North Korean armor). Indeed, tunnels inside North Korea could potentially be used to stage North Korean armor forward from its peacetime locations, thus avoiding the danger of operating on the roads and the poor quality of the roads. To carry this point to the extreme, if North Korean tunnels went below Seoul and the Han River, North Korea could insert armor in operational depth on D-Day, making it more likely that the North Koreans could secure crossing sites on the Han River, providing

alternatives to such crossing sites,¹² allowing North Korean armor to directly suppress several key air bases, and placing the North Korean advance in front of the refugees from Seoul who might otherwise clog the roads to the south.

The counter-capability framework provides a structure for organizing the range of approaches that the North Koreans might take to countering U.S. air power. To fill in this framework, the results of war games and other exercises can provide useful concepts of operations that analysts might ignore.

Performing the Analysis

This appendix has described a series of operational concepts and trade-offs associated with whether or not the ROK forward defense might fail in Korea. To evaluate that question, a wide range of issues must be assessed, including for example the ability of North Korea to counter U.S. air forces. We have not attempted to complete the analysis of such issues here but rather simply to identify issues that would have to be examined (and even so have been more illustrative than exhaustive). Moreover, analysis would also have to extend to the strategic events that might flow from some of these operational/tactical events (for example, how might U.S. resolve toward Korea be changed if the artillery terror operational concept destroyed the cohesion of the forward defense on D-Day, killing many Americans, and North Korean armor units destroyed America air forces at Osan also on D-day?). The analysis would need to identify possible sequences of events and the reactions by each side, assess the key sensitivities in the analysis, and determine the relative potential for the differing kinds of outcomes in each case.

We hope to pursue such an analysis in the future.

¹²If these tunnels could be maintained in operation, they would also provide a relatively secure avenue of advance for North Korean logistical flows, which otherwise face a gauntlet caused by CFC air forces.

References

- Patrick D. Allen, *Situational Force Scoring: Accounting for Combined Arms Effects in Aggregate Combat Models*, N-3423-NA, RAND, 1992.
- Patrick Allen, "Improving the Representation of Battle Types in Air-Ground Combat Models," *Military Science & Modeling*, RAND, May 1993.
- Graham T. Allison, *Essence of Decision: Explaining the Cuban Missile Crisis*, Little Brown and Company, Boston, MA, 1971.
- Les Aspin, *The Bottom-Up Review: Forces For a New Era*, Department of Defense, September 1993. Accompanying this document is a briefing on the "Bottom-Up Review," dated 1 September 1993.
- Bruce W. Bennett, et al., *RSAS 4.6 Summary*, N-3534-NA, RAND, 1992.
- Bruce W. Bennett, *North Korean Campaign Planning in JCLASS 92*, DR-115-NA, RAND, December 1992.
- Bruce W. Bennett, *Global 92 Analysis of Prospective Conflicts in Korea in the Next Ten Years*, N-3544-NA, RAND, 1993.
- Bruce Bennett, Margaret Cecchine, Daniel B. Fox, and Samuel Gardiner, *Technology and Innovations in Future Warfare: Wargaming the Persian Gulf Case*, N-3603-NA/OSD/AF/A, RAND, 1993.
- Bruce W. Bennett, "Flexible Combat Modeling," *Simulation & Gaming*, June 1993, pp. 213-229 (also available as a RAND reprint, RP-220).
- Bruce Bennett and Daniel B. Fox, "Theater/Strategic Bombing: Lessons from Strategic Targeting," *RSAS Newsletter*, RAND, January 1992.
- Bruce Bennett, "Ground Combat C3I Effects," *RSAS Newsletter*, RAND, January 1992.
- Bruce Bennett, "Adjudicating Ground Combat," *RSAS Newsletter*, RAND, April 1992.
- Bruce Bennett, Daniel B. Fox, Margaret Cecchine, and Samuel Gardiner, "Future of Warfare: Gaming Issues Resulting from a Persian Gulf Scenario," *RSAS Newsletter*, RAND, April 1992.
- Bruce Bennett and Daniel B. Fox, "The Effects of C3I on Major Regional Contingencies," *RSAS Newsletter*, RAND, April 1992.
- Bruce Bennett, "Military Modeling of Alternative Warfare Environments," *RSAS Newsletter*, RAND, August 1992.

- Bruce Bennett, "The Future of War—Initial Wargame Observations," *RSAS Newsletter*, RAND, November 1992.
- Bruce Bennett, "Defining a Structure for Analyzing Major Regional Contingencies," *RSAS Newsletter*, RAND, February 1993.
- Bruce Bennett, "Operational-Level Analysis and Modeling," *RSAS Newsletter*, RAND, February 1993.
- Bruce Bennett, "A Counter-Capability Framework for Evaluating Military Capabilities," *RSAS Newsletter*, RAND, February 1993.
- Bruce Bennett and Patrick Allen, "The Discontinuity in Theater Analysis and Modeling," *Military Science & Modeling*, RAND, May 1993.
- Bruce Bennett, "Asymmetrical Battles," *Military Science & Modeling*, RAND, May 1993.
- Bruce Bennett, "The Value of Air Power Across Some Dimensions of Future Warfare," *Military Science & Modeling*, RAND, August 1993.
- Bruce Bennett, "Countering North Korean Nuclear Proliferation," *Military Science & Modeling*, RAND, August 1993.
- Carl von Clausewitz, *On War*, edited and translated by Michael Howard and Peter Paret, Princeton University Press, Princeton, NJ, 1976.
- Defense Intelligence Agency, *North Korea: The Foundations of Military Strength*, October 1991.
- Department of Defense, *Conduct of the Persian Gulf War*. Final Report to Congress, April 1992 (three volumes).
- C.J. Dick, *Russian Views on Future War*, Conflict Studies Research Centre, The Royal Military Academy Sandhurst, June 1993.
- Director of Defense Research and Engineering, *Defense Science and Technology Strategy*, July 1992.
- T. N. Dupuy, *Numbers, Predictions, and War: Using History to Evaluate Combat Factors and Predict the Outcome of Battles*, The Bobbs-Merrill Company, Inc., Indianapolis, IN, 1979.
- Daniel B. Fox and Bruce Bennett, "The Future Military Environment and Military Modeling," *RSAS Newsletter*, RAND, November 1992.
- Daniel B. Fox, "Counter-Capability Air Campaigns," *RSAS Newsletter*, RAND, February 1993.
- Daniel B. Fox and John Bordeaux, *Global 92 Analysis of Prospective Conflicts in Central Europe in 2002*, N-3547-NA, RAND, 1993.
- Daniel B. Fox, "Atoms for Peace," *Military Science & Modeling*, RAND, August 1993.

- Samuel Gardiner, "Combat Effectiveness in Joint and Combined Operations," *RSAS Newsletter*, RAND, January 1992.
- Samuel Gardiner, "The Panoptic Effect of Airpower," *RSAS Newsletter*, RAND, January 1992.
- Samuel Gardiner, "The Lineage of the Nonlinear Battle," *RSAS Newsletter*, RAND, January 1992.
- Samuel Gardiner, "Overwhelming Force: A Guide for Policy or a Strategic Principle for Historians?" *RSAS Newsletter*, RAND, January 1992.
- Samuel Gardiner, "The Military-Technical Revoultion: More Than Military and More Than Technical," *RSAS Newsletter*, RAND, January 1992.
- Samuel Gardiner, "The Logic of Operational Art," *RSAS Newsletter*, RAND, November 1992.
- Samuel Gardiner, "It Isn't Clear Ahead, But I Think I Can See the Edges of the Road: The Character of Future Warfare," *RSAS Newsletter*, RAND, November 1992.
- Samuel Gardiner, "Microworlds: An Alternative to Scenarios," *RSAS Newsletter*, RAND, February 1993.
- Samuel Gardiner, "Playing With Nuclear Weapons," *RSAS Newsletter*, RAND, February 1993.
- Samuel Gardiner, "The Nonlethal Revolution in Warfare: Maybe Not Such a Revolution," *Military Science & Modeling*, RAND, May 1993.
- Samuel Gardiner, "Even Nonlethal Weapons Might Kill the Notion of Peacemaking," *Military Science & Modeling*, RAND, August 1993.
- Samuel Gardiner and Bruce Pirnie, "A Perspective on the Persian Gulf Campaign," *Military Science & Modeling*, RAND, August 1993.
- Samuel Gardiner, "High Tech Commandos: The Swedish Version of the Fragmented Battlefield," *Military Science & Modeling*, RAND, August 1993.
- Samuel Gardiner, "Playing With Mush: Gaming Lesser Contingencies," *Military Science & Modeling*, RAND, November 1993.
- Korean Overseas Information Service, *Undermining Peace: The Fourth Infiltration Tunnel*, 1990.
- Marc Dean Millot, Roger Molander, and Peter Wilson, "The Day After . . .": *Nuclear Proliferation in the Post-Cold War World—Volume 1: Summary Report*, MR-266-AF, RAND, 1993.
- Roger C. Molander and Peter A. Wilson, *The Nuclear Asymptote: On Containing Nuclear Proliferation*, MR-214-CC, RAND, 1993.
- Bruce Pirnie, *Global 92 Analysis of Prospective Conflicts in the Persian Gulf in 2002*, N-3546-NA, RAND, 1993.

John Y. Schrader, *Global 92 Analysis of Prospective Conflicts in the Tigris-Euphrates Watershed in 2002*, N-3545-NA, RAND, 1993.

Barbara W. Tuchman, *The Guns of August*, Macmillan Publishing, New York, NY, 1962.

Martin van Creveld, *Technology and War: From 2000 B.C. to the Present*, The Free Press, New York, 1989.